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PHYSICS ABSTRACTS

SECTION A

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SCIENCE ABSTRACTS

SECTION A, PHYSICS
SECTION B, ELECTRICAL ENGINEERING

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ABSTRACTS 4550–5266

VOLUME 56 **JULY 1953** NUMBER 667

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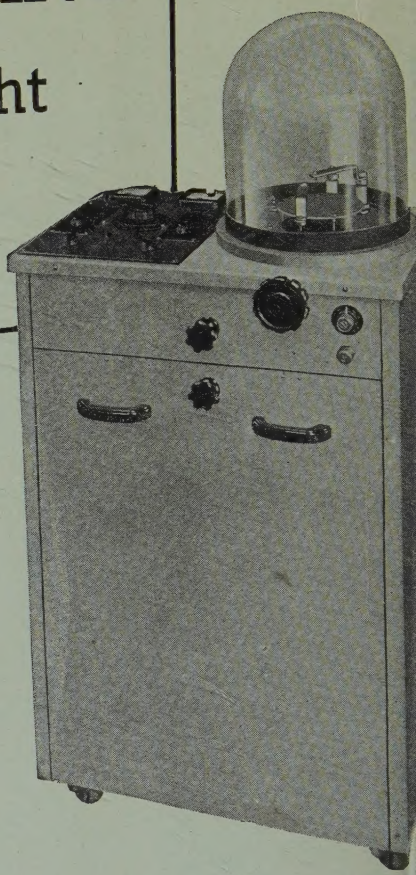

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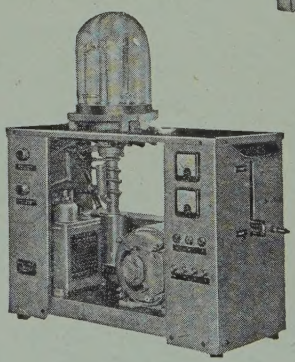

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RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

Electrical and magnetic measurements and instruments

Electronic relays and counters

Automatic control mechanisms

Applied electrochemistry

Photocells

Thermionic tubes

Cathode-ray tubes

X-ray tubes

Amplifiers

Radiocommunication

Mechanical engineering

Illumination

LIST OF JOURNALS

The following list supplements the List of Journals published with the January number of Volume 56 (1953). Reprints of the List of Journals can be obtained from the Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s. 0d. post free.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Bull. Elect. Engng Dep. Univ. Tokyo — *Bulletin of the Electrical Engineering Department, University of Tokyo.* Electrical Engineering Department, Faculty of Engineering, University of Tokyo.

J. Fac. Engng Univ. Tokyo — *Journal of the Faculty of Engineering, University of Tokyo.* Bunkyo-ku, Tokyo. [Being resumption of publication of pre-war *Journal of the First Faculty of Engineering, Tokyo Imperial University* (last issue *February*, 1943).]

J. Meteorol. — *Journal of Meteorology.* American Meteorological Society. 3 Joy Street, Boston 8, Massachusetts.

New Journal

J. Audio Engng Soc. — *Journal of the Audio Engineering Society.* P.O. Box 12, Old Chelsea Station, New York 11, N.Y. Quarterly. Vol. 1, No. 1 dated *January*, 1953.

Notes

Research — Address changed to 88 Kingsway, London, W.C.2.

Atti della Fondazione Giorgio Ronchi e Contributi dell'Istituto Nazionale di Ottica. Title extended from *Atti della Fondazione Giorgio Ronchi.*

Errata

Abstr. 3007 (1953) line 7: *for* KM_2O_4 *read* $KMnO_4$.
Abstr. 3543 (1953) line 1: *for* **half-live** *read* **half-life.**

Corrections to Articles

Corrections have been published, as shown below, to the articles whose abstract numbers are given. Unless otherwise stated, the volume and page given refer to the journal named in the abstract, i.e. the journal in which the original article was published.

Abstr. 1303 (1952): **134,** *No.* 4, 425 (1953).
Abstr. 1486 (1953): **43,** 409 (*May*, 1953).
Abstr. 1560 (1953): **43,** 409 (*May*, 1953).
Abstr. 709 (1953): **25,** 576 (*May*, 1953).
Abstr. 713 (1953): **25,** 576 (*May*, 1953).

MATHEMATICS 51

513.811 ; 530.1

4550. On finite approximation of solutions of two ordinary differential equations belonging to the classical quantum mechanics. G. JÄRNEFELT. *Ann. Acad. Sci. Fennicae, A I, No.* 138, 23 *pp.* (1952).

Approx. polynomial solutions of $dy/dx = \lambda y$ and of $-d^2y/dx^2 + x^2y = \lambda y$ are represented as pairs of numbers belonging to a Galois field. The investigation is undertaken as a development of the author's conjecture that fundamental physical theory can be expressed in terms of a finite geometry [Abstr. 2340 (1952)]. R. A. NEWING

513.811 : 530.1

On the fundamental prime of a finite world. *See Abstr.* 4582

517.5 : 530.145

4551. Dirac's function and its use in mathematical physics. S. COLOMBO. *Ann. Télécomm.*, **8**, 131–44 (*April*, 1953) *In French.*

Various formal properties of the Dirac function are reviewed, and some of the advantages gained by the use of the function in quantum mechanics and operational methods are pointed out. Certain of these properties are justified by the use of singular integrals and Bochner's theorem relating to these integrals. The use of the Dirac function in the (Césàro) summation of certain divergent integrals is discussed. L. S. GODDARD

517.9

4552. On reducible non-linear differential equations occurring in mechanics. C. W. JONES. *Proc. Roy. Soc. A*, **217**, 327–43 (*May* 7, 1953).

The purpose of this paper is to present a new method of approach to certain problems in mechanics which give rise to ordinary non-linear differential equations of the second order. The method, which is based on the topology of the integral curves of a first-order differential equation, aims at providing qualitative information which can be used, if necessary, in guiding numerical calculations of the solutions. Among the equations discussed are those of Emden and Blasius, which occur in astrophysics and in boundary-layer theory respectively; these, together with the equation of a basic problem of internal ballistics, are shown to be reducible to different forms of the same first-order equation, which is itself of a type studied originally by Poincaré in another connection. A.

517.947

4553. Formulae for the numerical integration of the wave equation. I. T. H. VAN DEN DUNGEN. *Bull. Acad. Roy. Belgique Cl. Sci.*, **38**, *No.* 1–2, 39–49 (1952). *In French*

517.947

4554. Formulae for the numerical integration of the wave equation. II. F. H. VAN DEN DUNGEN. *Bull. Acad. Roy. Belgique Cl. Sci.*, **38**, *No.* 7, 669–84 (1952) *In French.*

Extends Pt I by developing an approximate integration method for the equation $U_{xx} + U_{yy} = U_{tt}/c^2$, which treats the x–y plane isotropically. The necessary formulae are obtained and the convergence of the method established. Extension to n-dimensional space is discussed. R. H. DALITZ

517.948.32

4555. A generalization of the symmetrical kernel of an integral equation. P. LAASONEN. *Ann. Acad. Sci. Fennicae, A I, No.* 118, 33 *pp.* (1952) *In German.*

An investigation of the existence and properties of the eigenvectors $u(x)$ and eigenvalues λ of the equation $u(x) = \lambda \int k(x,y)u(y)dy$, where for a given square matrix $k(x,y)$ there exists a matrix S such that $S(x)k(x,y) = k'(y,x)S(y)$, k' being the transpose of k. R. A. NEWING

519.2

4556. Introduction to the theory of stochastic processes depending on a continuous parameter. H. B. MANN. *Appl. Math. Ser. Nat. Bur. Stand. No.* 24, 44 *pp.* (1953).

A stochastic process is here defined as a family of distribution functions satisfying certain consistency relations. The theory is developed from this point of view with the least appeal to abstract measure theory. Fundamental concepts are discussed in chapter 1, including convergence in the mean, differentiation and integration, and stochastic processes of the second order. In chapter 2 special processes are studied. What is called the "fundamental random process" is defined. It is a Markoff process, and a special case is the Brownian motion of the particles of a gas. Next frictional effects are considered, and these involve the Ornstein–Uhlenbeck process. Chapter 3 is concerned with the estimation of parameters, and chapters 4 and 5 with differential processes, including those modified by mechanical devices. Here the filter effect and counter data are discussed. Chapter 6 deals with the Fourier analysis of stochastic processes. L. S. GODDARD

ASTRONOMY . ASTROPHYSICS . GEODESY 52

522.2 : 537.533.72 : 621.389 : 621.385.833

4557. A light receiver of very high sensitivity: the electronic telescope. Study and improvement. M. DUCHESNE. *Bull. Astron.* [*Paris*], **17**, *No.* 1, 88 *pp.* (1953) *In French.*

In an electronic telescope, the image to be studied is formed on a photoemissive cathode. The electrons emitted by the cathode are accelerated by an electric field, and focused by electron optics to form a reconstituted image on a fluorescent screen or photographic plate. A detailed analysis of the performance characteristics of such an electron telescope is made.

Formulae for the calculation of the position and size of the image and the axial potential for an objective consisting of a plane cathode and two diaphragms are established. A numerical method of calculating the trajectories of the marginal electrons is developed, and applied to the evaluation of field curvature. A systematic analysis of sources of stray illumination is made; the effects of potential gradients of the order of 400 V/cm in the neighbourhood of the cathode, of positive ions from the gases present in the tube, and of secondary and reflected primary electrons, are small, except at the edges of the field. An experimental investigation leads to the conclusion that the photoelectric surface considered consists of a large number of microscopic elements possessing different energies of extraction, and that the photoelectric sensitivity of a Ag–Cs_2O–Cs surface is increased by decreasing the temperature.

M. W. OVENDEN

523.112

4558. Expansion of the universe and the cosmological field. L. ROY. *C.R. Acad. Sci.* [*Paris*] **236,** 763–5 (*Feb.* 23, 1953) *In French.*

In a universe of total mass M consisting of a finite number of galaxies which move in rectilinear motion with linear recession $\dot{r} = kr$, Newtonian equations of motion show that each galaxy of mass m gives rise to a radial repulsive field of intensity k^2mr/M. The ratio of this cosmological field to the corresponding gravitational attraction Gm/r^2 is estimated as $2\times10^{-26}r^3$, where r is in light years, for a universe of radius 10^9 light years. R. A. NEWING

523.112

4559. Expanding universe and the origin of galaxies. G. GAMOW. *K. Danske Vidensk. Selsk., mat.-fys. Medd.,* **27,** *Paper* 10, 15 *pp.* (1953).

Thermal radiation is regarded as initially predominant, but, with expansion, mass density becomes the important factor, and primordial gas becomes broken up into gas clouds whose minimum sizes are determined by Jeans' formula for gravitational instability as modified by Chandrasekhar for application to a turbulent medium. Densities implied by the theory for the initial radiation stage are also consistent with the requirements of a theory of the origin of atomic species. R. A. NEWING

523.112 : 530.12

Gravitation and cosmic expansion in conformal space-time. *See Abstr.* 4586

523.53 : 538.566.3

4560. On the decay of radio echoes from meteor trails. T. R. KAISER AND J. S. GREENHOW. Letter in *Proc. Phys. Soc* [*London*] *B,* **66,** 150–1 (*Feb.*, 1953).

Feinstein's objection to the diffusion theory of the decay of radar meteor echoes, namely that the recombination coefficient of the E-region (10^{-8} cm^3. sec^{-1}) should apply to meteor trails, is considered invalid since neither electron loss through attachment nor through dissociative recombination would be important in electron trails at heights of 90 km, the meteor atoms having lower ionization potentials than the atmospheric constituents. Observational evidence for an effective recombination coefficient of 5×10^{-10} cm^3. sec^{-1} in typical meteor trails is cited. The complex structure of the echoes and the simultaneity of fluctuations on different wavelengths is unexplained on Feinstein's hypothesis of interference between waves reflected at different levels of the cylinder of ionization, but finds a ready explanation as an interference effect arising from trail distortion by upper atmospheric winds. M. W. OVENDEN

523.677 : 551.513 : 536.25

The instability of a layer of fluid heated below and subject to Coriolis forces. *See Abstr.* 4762

523.72

4561. Numerical evaluation of the integral equation for the sun's limb-darkening in order to derive the source function. H. MINEUR AND R. PEYTURAUX. *Ann. Astrophys.,* **15,** 383–401 (*Oct.–Dec.*, 1952) *In French.*

Examination of the relation between $\phi(\mu)$ (i.e. limb-darkening observed at a point with the position angle θ, relative to the sun's centre; $\cos\theta = \mu$), and the source function $S(\tau)$, (where τ the optical depth). Measurements of $\phi(\mu)$ were made at the observatory on the Pic du Midi. It is shown that Laplace's transformation formula cannot be applied to obtain a solution of the resulting integral equation. A special interpolation method is worked out in successive approximations, and a close agreement with the observations is established. A. BEER

523.746.5

4562. The sunspot number series. R. N. BRACEWELL. *Nature* [*London*] **171,** 649–50 (*April* 11, 1953).

The object of this new analysis of the sunspot numbers, covering 18 eleven-year cycles going back to 1750, is stated by the author to have been twofold: to discover a process which would yield a time series resembling the sunspot series, and to predict the future of this series, which would not be as empirical as until now and would also be valuable for telecommunication research. The idea is advanced (stimulated by Hale's observations of the polarities of sunspots), that the sunspot cycle does not last 11 but 22 years. This is illustrated by plotting alternate cycles with positive and negative signs, respectively. Thus a curve is obtained which is symmetrical about its mean value, the latter being practically zero. This representation shows the correlation between the fall of the sunspot number in one cycle to zero and the rise in the following cycle, e.g. a steep rise might be expected to follow a steep fall to zero, etc.; typical examples of this are pointed out. A. BEER

523.755

4563. A theoretical model for arches in the solar corona. J. W. DUNGEY. Letter in *Nature* [*London*] **171,** 618 (*April* 4, 1953).

In the model investigated the temperature and composition of the solar atmosphere are assumed to be uniform; the same is done for the gravitational field, while the magnetic field is taken as two-dimensional. Some over-simplification is emphasized, since, for example, the prominences are much cooler than the corona; but the author's formulae are probably applicable to the arches seen in the corona

above prominences, as these may be nearly isothermal. Here agreement is demonstrated between the calculated and the observed shapes, which indeed fit together for a temperature of 10^6 °K, which, on the other hand, is today's accepted value for the temperature of the corona. A. BEER

523.76

4564. The abundance of deuterium in the solar atmosphere. D. CRESPIN. *Bull. Acad. Roy. Belgique Cl. Sci.*, **38**, *No.* 8–9, 838–50 (1952) *In French.*

A knowledge of the relative amounts of D and H in the sun is important in studies of its atmospheric circulation and internal constitution. The author discusses the earlier work of Menzel (1932), and Gauzit (1952) on the abundance of heavy H, based on profile measures of the Balmer and Paschen lines of D and H. From a study of available profiles of $D\beta$(4860·029 Å) and D_{3-5}(12814·64 Å) equivalent widths of these lines are 0·0041 Å, and 0·0027 Å respectively. The corresponding equivalent widths of $H\beta$ and H_{3-5} are 3·80, and 4·39 Å. It is concluded that the solar abundance of D is therefore much less (~1 : 100) than that for the earth. D. R. BARBER

523.77

4565. Measurement of the equivalent width of a spectral line—the influence of resolving power. J.-C. PECKER AND H. VAN REGEMORTER. *Ann. Astrophys.*, **15**, 364–73 (*Oct.–Dec.*, 1952) *In French.*

Portions of microphotometer tracings from the Utrecht atlas of the solar spectrum are transformed to represent the effects of various smaller resolving powers, and equivalent widths of some blended lines measured in each transformed tracing. When the estimated contour of the principal line was used (eliminating blends as far as possible throughout) the resulting W increased rapidly with poorer resolving power; but if the whole contour (including all blends) was used, then W remained approximately constant. The importance of other factors (dispersion, grain, etc.) and of their separate investigation is emphasized. D. L. EDWARDS

523.77

4566. Are the forbidden lines of neutral iron and ionized nickel present in the solar spectrum? J. SWENSSON. *Bull. Acad. Roy. Belgique Cl. Sci.*, **38**, *No.* 7, 705–10 (1952) *In French.*

The presence in the solar spectrum of forbidden lines due to Fe I and Ni II is considered. Although some evidence suggests that certain [Fe I] and [Ni II] transitions may be weakly represented in absorption in the spectrum of the solar disk, no conclusive identification has been made. Absolute transition probabilities for [Fe I] and [Ni II] lines are badly needed. D. L. EDWARDS

523.77

4567. Lyman-alpha-line photographed in the sun's spectrum. W. B. PIETENPOL, W. A. RENSE, F. C. WALZ, D. S. STACEY and J. M. JACKSON. Letter in *Phys. Rev.*, **90**, 156 (*April* 1, 1953).

A complex automatic, electronic and mechanical sun-seeking device, or pointing-control, has been developed during the past three years at the Physics Department of the University of Colorado at Boulder, intended for installation on high altitude rockets. It is now used to hold a spectrographic equipment pointing at the sun for a considerable period during the flight of a rocket, whatever its most involved movements. On December 12, 1952, an Aerobee rocket thus succeeded in obtaining at a height of over 50 miles a 28 seconds' exposure of the sun's spectrum. For the first time the ultraviolet hydrogen radiation was photographed far beyond the previous limit of 2000 Å. The Lyman-alpha-emission at 1216 Å is prominent, its width about 6 Å, and its intensity outside the earth's atmosphere about 0·03 microwatt per cm^2. A. BEER

523.77 : 535.343.4

4568. Fine structure of the absorption band of ozone at 9·6 μ observed in solar and laboratory spectra. M. MIGEOTTE, L. NEVEN AND E. VIGROUX. Letter in *Physica*, **18**, 982–4 (*Nov.*, 1952) *In French.*

The solar band between 9·346 μ and 10·152 μ is observed. Nearly all details agreed with those of the ozone band taken in the laboratory though the resolving power in the solar spectrum was somewhat better. The observed frequencies were classified in four series and tabulated. Formulae for the description of these series were calculated. A. J. TAYLOR

523.77 : 551.510.41

4569. The absorption due to carbon monoxide in the infrared solar spectrum. J. L. LOCKE AND L. HERZBERG. *Canad. J. Phys.*, **31**, 504–16 (*May*, 1953).

New tracings of the absorption bands due to CO in the 4·7 μ and 2·4 μ regions of the solar spectrum were obtained with a spectrometer of high resolving power. From the observed absorption intensity at 4·7 μ the abundance of CO in the earth's atmosphere over Ottawa was found, during spring and fall 1952, to vary between 0·1 and 0·2 cm-atm. Similar observations, made at other stations, were re-evaluated with the laboratory data used at Ottawa. The values for the CO abundance in the earth's atmosphere at different geographical locations, determined in this way, were found to be within the limits of the values obtained at Ottawa. Absorption lines due to solar CO in the 4·7 μ region of the spectrum were resolved. Their intensity relative to the intensity of the solar CO absorption in the 2·4 μ region of the spectrum was found to be in agreement with expectations based on the theoretical curves of growth for solar absorption lines. A.

523.775

4570. Contribution to the study of the continuous solar spectrum in the near infrared. R. PEYTURAUX. *Ann. Astrophys.*, **15**, 302–51 (*July–Sept.*, 1952) *In French.*

The present view that the main cause of absorption in the solar atmosphere between 6000 and 12 000 Å is the negative hydrogen ion H^- has been tested for longer wavelength regions. Pt I gives the experimental arrangement, with the use of a PbS cell, of a new series of measurements of the limb-darkening, covering 15 wavelengths between 6700 and 23 000Å and with central distances up to 0·986 solar radii. In Pt II the energy distribution at the centre is investigated for 15 λ-values, and compared with Abbot's

corresponding older observations; the agreement with Abbot's 1913 series is reasonable, but his second series, of 1922, shows discrepancies reaching 25%. The author then describes in Pt III his model of the solar atmosphere, studies the photospheric absorption, finds that the ion H^- is practically the only cause of this absorption, and confirms Chandrasekhar's and Breen's calculations of the absorption coefficients.

A. BEER

523.775

4571. Investigation of the forbidden lines ^2D–^2P of neutral nitrogen in the absorption spectrum of the sun's atmosphere. J. DUFAY. Note in *Ann. Astrophys.*, **15,** 359–60 (*July–Sept.*, 1952) *In French.*

It is suggested that the faint line λ10 397·57 Å may correspond to one of the forbidden transitions of N I. The other component of this doublet, however, whose intensity should be about the same, is masked by a strong line of unknown origin. Because of this situation it is impossible to determine the number of nitrogen atoms contained in the solar atmosphere.

A. BEER

523.852.3

4572. On the dynamics of stellar systems. B. LINDBLAD AND R. G. LANGEBARTEL. *Stockholms Obs. Ann.*, **17,** *No.* 6, 61 *pp.* (1953).

Lindblad's theory of rotating systems is here restated in an extended form. A "standard" stellar system is introduced in which the general relative velocity dispersion α in the equatorial plane decreases with distance from the axis of rotation according to the law $\alpha^2 = \alpha_0^2(1 - r^2/a^2)$. The properties of density waves in the standard system are investigated and compared with waves in a homogeneous spheroid. Detailed consideration is given to the development of spiral structure and earlier results are confirmed.

R. A. NEWING

523.872 : 537.228.5

4573. Note on the theory of the Stark effect in stellar spectra. G. J. ODGERS. *Astrophys. J.*, **116,** 444–6 (*Sept.*, 1952).

Reasons are given for doubting the validity of the Holtsmark probability distribution of the electric field and its steady state, which are bases of Verweij's theory of the Stark effect in stellar atmospheres. It is suggested that the great width of the hydrogen lines in A-type stars is mainly due to the perturbing effect of electrons.

D. L. EDWARDS

523.872 : 537.228.5

4574. Note on the Stark broadening of Hγ. A. B. UNDERHILL. *Astrophys. J.*, **116,** 446–8 (*Sept.*, 1952).

Computed profiles based on a model stellar atmosphere, and assuming Stark effect due to protons only, do not agree with observed profiles in two stars of suitable spectral type, implying that the effect of electrons must be important in producing the broadening of H_γ.

D. L. EDWARDS

523.877

4575. Note on the periods of pulsation of stars of high mass concentration and the problem of the Cepheids. P. LEDOUX. *Bull. Soc. Roy. Sci. Liège,* **21,** 408–20 (*Nov.*, 1952) *In French.*

The effect of exterior layers of small mass upon the fundamental period of a star with high central concentration is discussed. Numerical calculations are made for a giant star model with a thin outer layer of uniform density. The presence of the outer layer leads to an appreciable increase in the period, which is, however, less than that suggested by Epstein [Abstr. 8461 (1950)]. It is concluded that the effect of outer layers is unlikely to be large enough to provide agreement between the theoretical and observed periods of Cepheids.

R. A. NEWING

523.877

4576. Connection between radiative and adiabatic zones: case of an atmosphere composed of H and He. C. PECKER. *C.R. Acad. Sci.* [*Paris*] **236,** 585–7 (*Feb.* 9, 1953) *In French.*

A continuation of previous research on model stellar atmospheres [Abstr. 6006 (1951)]. The work is here extended to include 4 different H–He models, for which the convective zone may be represented by the same adiabatic relation.

D. R. BARBER

523.877 : 532.51 : 538.3

Generalized magneto-hydrodynamic formulae. *See Abstr.* 4919

523.877 : 539.172.13

4577. The reaction rate of the proton-proton chain. E. E. SALPETER. Note in *Astrophys. J.*, **116,** 649–50 (*Nov.*, 1952).

The rate of the proton-proton thermonuclear reaction chain is controlled by the slowest reaction of the chain, viz. $H^1 + H^1 \rightarrow D^2 + e^+$. The most recent data are used to calculate the rate of energy production for cases typical of central conditions of various main-sequence stars. Whereas the calculated very small equilibrium concentrations of deuterium are in agreement with spectroscopic observations on stellar atmospheres, they are seriously smaller than terrestrial concentrations, which may suggest that the earth could not have come from the interior of a main-sequence star.

G. M. BROWN

525.35

4578. Long-period fluctuations of the velocity of rotation of the earth and the characteristics of the Chandlerian movement of the pole. P. J. MELCHIOR. *Bull. Acad. Roy. Belgique Cl. Sci.*, **38,** *No.* 11, 1044–50 (1952) *In French.*

An extension of a previous investigation [see Abstr. 3252 (1952)] to include observational material prior to 1900. Variation of amplitude, and of period of the Chandlerian movement is expressed by formulae of Kimura type. A negative conclusion is reached regarding a possible correlation of the Chandlerian motion, and fluctuations of the rate of the earth's rotation.

D. R. BARBER

525.35 : 550.341.2

Fluctuations in the earth's rotation and seismic activity. *See Abstr.* 5225

PHYSICS 53

53.08 : 519.2

4579. Associated measurements. M. H. QUENOUILLE. *London: Butterworth's Scientific Publications*, x + 242 *pp.*

Review in *Brit. J. Appl. Phys.*, **4**, 125 (April, 1953). "The application of statistical methods to research problems . . . methods adapted to the study of association between quantitative measurements. . . ."

53.081.5

4580. Dimensional theory: dimensionless secondary quantities. L. L. WHYTE. *Amer. J. Phys.*, **21**, 323–5 (*May*, 1953).

In realms where natural constants, l_0, t_0 or v_0, of length, time and/or velocity, are present, dimensionless secondary quantities can be defined of the form $Q' = f(l_0/l, t_0/t, v_0/v$, etc.) which are not, in general, expressible as a constant × the product of powers of primary quantities. It is suggested that dimensionless quantities of the form Q' are required in the theory of interactions. A.

FUNDAMENTALS 530.1

530.1

4581. Rationalization of discovery. I. Definition of elements of dissymetry. P. RENAUD. *C.R. Acad. Sci.* [*Paris*] **236**, 668–70 (*Feb.* 16, 1953) *In French.*

Methodology. Discusses how Pasteur–Curie's vague concept of "dissymetry" may be made more precise. The rules of combination of elements of dissymetry differ from those of symmetry. It is deduced that to obtain an assembly of dissymetries at a given place L, an assembly of physical systems or apparatuses must be constructed which is capable of presenting in every element of volume of L a local dissymetry which is at least equal to that which it is desired to obtain at the particular point of L.

S. WEINTROUB

530.1 : 513.811

4582. On the fundamental prime of a finite world. P. KUSTAANHEIMO. *Ann. Acad. Sci. Fennicae, A I, No.* 129, 7 *pp.* (1952).

A finite geometry based on a Galois field with the prime characteristic p will approximate to Euclidean geometry in certain regions [see Abstr. 2340 (1952)]. This approx. would fail at small and large distances, and if such distances are interpreted as of atomic and astronomical magnitudes, it would be possible in principle to determine the smallest non-residue prime q_{k+1} from physical observations. The paper discusses the problem of determining the fundamental prime p if q_{k+1} is known. R. A. NEWING

530.1 : 513.811

On finite approximation of solutions of two ordinary differential equations belonging to the classical quantum mechanics. *See Abstr.* 4550

530.12

4583. The invalidity of Birkhoff's theorem in the extended theory of gravitation. P. JORDAN. *Z. Phys.*, **133**, *No.* 4, 558–60 (1952) *In German.*

Particular integrals of the author's field equations, in which the constant of gravitation is replaced by a scalar field, show that spherically symmetric fields in empty space are not necessarily static.

R. A. NEWING

530.12

4584. The physical meaning of auxiliary conditions in the theory of gravitational waves. F. A. KAEMPFFER. *Canad. J. Phys.*, **31**, 501–3 (*May*, 1953).

The conditions are examined which are necessary to reduce the gravitational field equations in first approximation to a set of ordinary wave equations. These conditions are evaluated for the case of the gravitational field produced by an accelerated particle, and it is shown that they restrict the consideration to observers whose radius vector towards the source of the field is perpendicular to the vector of acceleration of the particle at the retarded time. A.

530.12 : 523.112

4585. Conformal transformations and kinematical relativity. D. E. LITTLEWOOD. *Proc. Cambridge Phil. Soc.*, **49**, *Pt* 1, 90–6 (1953).

In conformal space-time $ds' = e^{\phi}ds$, where ds is the Minkowski metric, ϕ is interpreted as the gravitational potential and equations for free space are obtained by equating to zero the total curvature. The inertia of a body is stated to be inversely proportional to the total potential of all matter in the universe. Applied to Milne's expanding model, the requirement of finite potential implies finite total mass in general, but one density distribution allows finite potential with infinite total mass and gives $\rho_0\gamma T^2 = 1/4\pi$. R. A. NEWING

530.12 : 523.112

4586. Gravitation and cosmic expansion in conformal space-time. F. GÜRSEY. *Proc. Cambridge Phil. Soc.*, **49**, *Pt* 2, 285–91 (1953).

A simple theory of gravitation is formulated in conformal Riemannian space-time. The metric is determined by a scalar function which satisfies a linear equation. A conclusion in favour of Einstein's general tensor theory is drawn from a discussion of the corrections to the Newtonian theory for purely gravitational phenomena. Finally the theory is applied to the cosmological problem and especially to the possibility of a steady-state universe. The velocity-distance law is shown to be compatible with a constant uniform distribution of matter without the need of artificial assumptions. A.

530.12 : 531.18

4587. The Lorentz transformation. A. W. INGLETON. Letter in *Nature* [*London*] **171**, 618–19 (*April* 4, 1953).

The transformations are derived from Capildeo's assumptions by considering frames of reference moving in two perpendicular directions relative to a 3rd frame. R. A. NEWING

530.145

4588. Statistical investigation of the fundamental processes in the quantum theory of elementary particles. F. BOPP. *Z. Naturforsch.*, **8a**, 6–13 (*Jan.*, 1953) *In German.*

The basic processes of emission and absorption of a

particle at a point are analysed quantum-statistically and in elementary statistics. Any ensemble of basic processes may be considered in the latter way only when certain conditions are satisfied, and these mean that elementary statistics are appropriate to irreversible processes, whilst quantum-statistical processes are reversible. R. H. DALITZ

530.145

4589. On the objectivity of states in non-relativistic quantum theory. R. HAAG. *Z. Naturforsch.*, **8a**, 13–16 (*Jan.*, 1953) *In German.*

Discusses the possibility of relating objective state quantities to an isolated system, the concept of state satisfying two given requirements. The manifold of wave-functions allowed by these lead to difficulties so that the concept of state adopted here is not in fact applicable to quantum mechanics. R. H. DALITZ

530.145

4590. A variational approach to the unipotential many-electron problem. R. T. SHARP AND G. K. HORTON. Letter in *Phys. Rev.*, **90**, 317 (*April* 15, 1953).

Obtains the integral equation satisfied by a potential, the same for all electrons and such that the energy of the system is stationary for variation of the potential (and of the consequent wave functions). An approximate solution is given. R. H. DALITZ

530.145

4591. Spherically symmetric solutions in nonsymmetrical field theories. I. The skew symmetric tensor. P. C. VAIDYA. *Phys. Rev.*, **90**, 695–8 (*May* 15, 1953).

The spherically symmetric form of the skew tensor g_{ik}, given by Papapetrou, is not sufficiently general. A more general form is found. This necessitates a reconsideration of the programme of spherically symmetric solutions in nonsymmetrical field theories initiated by Papapetrou. The present paper makes a beginning in this direction. The new form of the spherically symmetric tensor g_{ik} is derived from a consideration of the infinitesimal rotation of a sphere about a diameter. It is hoped to use this form to obtain nonstatic solutions in nonsymmetrical field theories which will correspond to solutions of a radiating star in general relativity. A.

530.145

4592. On the divergence of perturbation theory for quantized fields. W. THIRRING. *Helv. phys. Acta*, **26**, *No.* 1, 33–52 (1953).

The convergence of perturbation theory is investigated for a scalar field with an interaction term $\lambda\psi^3$. It is shown that for a certain energy region the series diverges for all values of λ. A.

530.145

4593. Free electrons in unitary quantum electrodynamics. H. KÜMMEL. *Z. Phys.*, **134**, *No.* 1, 78–94 (1952) *In German.*

The zero-order operators of Ludwig's "unitary" theory (quantization of the Wheeler–Feynman electrodynamics) [Abstr. 4086 (1951)], are discussed, and it is shown that in hole theory the commutation relations differ from the usual ones already in the first approximation. Using Süssmann's simple absorber model [Abstr. 5531 (1952)], the effect of the absorbers can easily be included. Results agreeing with those of the "dual" (usual) theory are obtained for the Rutherford and Møller scattering, Compton effect and bremsstrahlung according to the one-electron theory. While the expressions for pair creation and annihilation are still unaltered, deviations will occur in the hole-theoretical results for all many-electron problems. W. A. HEPNER

530.145

4594. Conservation laws in classical electrodynamics. O. BERGMANN. Letter in *Phys. Rev.*, **90**, 315 (*April* 15, 1953).

For a generalization of Dirac's new classical electrodynamics having no Lagrangian, the symmetrical energy-momentum tensor consists of the sum of the usual Maxwell tensor and the matter tensor of relativity. R. H. DALITZ

530.145

4595. Theory of the electromagnetic vacuum (Preliminary report). F. A. KAEMPFFER. *Canad. J. Phys.*, **31**, 497–500 (*May*, 1953).

It is shown that, if one assumes Dirac's electrodynamics to be the correct description of the electromagnetic field at the absolute zero of temperature, the electromagnetic vacuum ("the Dirac sea") can be considered as a nonviscous fluid, in which pressure waves ("sound") travel with velocity c, and in which with rising temperature excitations appear as particles analogous to the excitations ("phonons" and "rotons") in ordinary nonviscous fluids at low temperatures. It is suggested that photons be considered as vortex-free excitations and charged particles as vortex excitations of the fluid representing the electromagnetic vacuum. Some evidence which supports this suggestion is given. A.

530.145

4596. Theory of the electromagnetic vacuum. I. F. A. KAEMPFFER. *Canad. J. Phys.*, **31**, 629–35 (*May*, 1953).

See preceding abstract. The reasons are restated and amended which make it possible to consider the electromagnetic vacuum as a nonviscous fluid in which excitations of the motion appear as observable particles. It is shown, in close formal analogy to Dirac's new electrodynamics, that the electromagnetic vacuum can be characterized at each point in space time by a scalar function κ, representing the ratio (energy density)/(charge density) of the medium, and by a four-vector v^μ, representing the state of motion of the medium at that point. As a first step towards quantization of this theory a spinor formulation of electrodynamics is set up which allows possible excitations of the vacuum to be classified. The programme for full quantization of this theory is outlined. A.

530.145

4597. Quantum field theory of bound states. II. Relativistic theory of resonance reactions. R. J. EDEN. *Proc. Roy. Soc. A*, **217**, 390–408 (*May* 7, 1953).

For Pt I, see Abstr. 1389 (1953). Relativistic quantum field theory is extended so that it can be used as a basis for a qualitative study of nuclear resonance reactions. The general resonance formulae are derived in a relativistic form, and the interference

between neighbouring levels is investigated. It is assumed that resonance arises from the formation of a compound nucleus which subsequently disintegrates. The essential features of resonance and level width are, in the first instance, derived from a simple resonating model. This shows that, while resonance arises directly from the Feynman propagator in lowest approximation, the level widths come from considering an infinite series of Feynman–Dyson diagrams; these can be represented by an integral equation. In considering a general nuclear resonance reaction it is necessary to use compound propagators, which were introduced by the author in Pt I. The general form of the compound propagator is obtained in stable approximation, and the integral equation is derived which allows for the possibility of disintegration. The solution of this equation leads to the relativistic formulae for a general resonance reaction. A.

530.145

4598. Statistical density of particle ensembles in the causal interpretation. J.-P. VIGIER. *C.R. Acad. Sci.* [*Paris*] **236,** 1003–5 (*March* 9, 1953) *In French.*

The result that the statistical density tends to $\psi^*\psi$ owing to elastic collisions occurring in a particle ensemble in causal theory, has a simple interpretation in the double solution theory, and assists discussion of the relation between Feynman theory and the statistical viewpoint of the causal theory.

R. H. DALITZ

530.145

4599. A remark on proper Lorentz transformation of Dirac's equations. M. BRDIČKA. *Bull. Internat. Acad. Tchèque Sci.*, **51,** 101–8 (1950).

Covariance with respect to the general transformation $x' = Ax$ is discussed, where $\tilde{A}A = I$ and $|A| = +1$. R. A. NEWING

530.145

4600. On the dynamics of a spinning point particle. J. HÉLY. Note in *Rev. sci.* [*Paris*] **90,** 135–6 (*March–April*, 1952) *In French.*

For a spinning particle, covariant classical dynamical relations are found connecting momentum, velocity, intrinsic angular momentum and their proper-time derivatives with the external forces and couples acting.

R. H. DALITZ

530.145

4601. Angular momentum and parity of systems composed of two identical bosons of zero mass. G. BONNEVAY AND L. MICHEL. *C.R. Acad. Sci.* [*Paris*] **236,** 461–2 (*Feb.* 2, 1953) *In French.*

Two bosons (mass zero, spin S) cannot form a system which has an odd total angular momentum J if either $J < 2S$ or the parity is odd. See also Abstr. 3306 (1952). R. H. DALITZ

530.145

4602. On the calculation of the cross-section for emission of bremsstrahlung by a particle of spin $h/2$ in interaction with a particle of spin $nh/2$. G. PETIAU. *C.R. Acad. Sci.* [*Paris*] **236,** 462–4 (*Feb.* 2, 1953) *In French.*

Calculates the cross-section for bremsstrahlung emission by a particle of spin $h/2$ which has Coulomb interaction with a particle of spin $nh/2$ (e.g. an atomic nucleus), using the higher spin theory discussed earlier [Abstr. 6285 (1952)]. R. H. DALITZ

530.145

4603. Coordinate operators and fundamental lengths. H. T. FLINT AND E. M. WILLIAMSON. Letter in *Phys. Rev.*, **90,** 318 (*April* 15, 1953).

To Snyder's [Abstr. 1120 (1947)] co-ordinate operator $M_{\mu 5}$($M_{\mu\nu}$ is the angular momentum operator) is added the term corresponding to the spin addition to $M_{\mu\nu}$. For this operator, e^2/mc^2 and $\hbar/mc$ are the smallest lengths which can be considered in the mechanics of the electron, parallel and normal to the electron motion respectively. R. H. DALITZ

530.145

4604. Space reflection, time reversal and charge conjugation of spinor fields. H. A. S. ERIKSSON. *Ark. Fys.*, **6,** *Paper* 33, 349–58 (1953).

The author's spinor formalism developed in terms of Cayley parameters is found to describe only particles of vanishing rest-mass unless the Lagrange density is invariant with respect to time reversal. The number of possible representations of space reflection is found to be two or four according as time reversal is or is not included in the Lorentz transformation. R. A. NEWING

530.145

4605. On the spin-orbit interaction and the saturation requirements. H. KANAZAWA. *Sci. Pap. Coll. Gen. Educ. Univ. Tokyo*, **1,** 37–40 (*Oct.*, 1951).

The expectation value of an interaction potential including spin-orbit coupling of the form $J(r_{12})(\sigma^{(1)} + \sigma^{(2)})[\boldsymbol{x}, \boldsymbol{p}]$ is evaluated between 2 plane wave Slater determinants. The spin-orbit contribution (like a tensor interaction) vanishes, so that the situation regarding saturation is unchanged. W. J. SWIATECKI

530.145

4606. Derivative matrix and scattering matrix. E. P. WIGNER. *Rev. Mexicana Fís.*, **1,** 81–90 (*July*, 1952) *In Spanish. English transl., ibid.*, 91–101.

Obtains a necessary condition (the alternation theorem) for the scattering matrix $S(E)$ to be derivable from a "permissible" $R(E)$ matrix (logarithmic derivative of the wave-function). R. H. DALITZ

530.145

4607. Boundary conditions and S [matrix] formalism of nuclear dispersion. J. M. LOZANO AND F. M. MEDINA. *Rev. Mexicana Fís.*, **1,** 102–13 (*July*, 1952) *In Spanish.*

It is shown that, in the absence of an essential singularity of S at infinity, the dynamical description suggested by the S-matrix formalism gives the same time-dependent wave-functions that are obtained when the interaction is represented by boundary conditions. The S-matrix formalism is then extended to the case when S may have an essential singularity at infinity. L. PINCHERLE

530.145

4608. On a class of integral transform in nuclear dispersion. M. MOSHINSKY. *Rev. Mexicana Fís.*, **1,** 114–26 (*July*, 1952) *In Spanish.*

A time-dependent Green function for the scattering by a short range potential is introduced which gives a complete dynamical description of the interaction

and can be used to derive the motion of any initial wave packet. L. PINCHERLE

530.145

4609. Anomalous magnetic moments of nucleons. II. F. E. PRIETO. *Rev. Mexicana Fis.*, **1**, 127–41 (*July*, 1952) *In Spanish.*

For Pt I, see Abstr. 610 (1953). The Feynman–Dyson procedure is applied to the calculation of the second order correction to the current due to the meson-nucleon coupling. L. PINCHERLE

530.145

4610. Mesonic interpretation of nuclear properties. R. G. MOORHOUSE. *Advances in Phys.*, **2**, 185–212 (*April*, 1953).

A review of the attempts to deduce nuclear properties from π meson field-theories. Anomalous single nucleon magnetic moments and neutron-electron interaction. Two-nucleon forces, including work of Levy (1952), Taketani *et al.* (1951), Machida *et al.* (1951). Brief mention of many-body systems and non-linear meson theory, Schiff (1951). Results of principal calculations are given in full and relevant experimental data are reproduced. About 90 references. W. J. SWIATECKI

530.145

4611. The limits of the quantum theory of wave fields. K. WILDERMUTH. *Z. Naturforsch.*, **8**, 105–16 (*Feb.–March*, 1953) *In German.*

An idealized one-dimensional (scalar) model is used to study some consequences of Heisenberg's theory [Abstr. 835 (1951)] that photons or π-mesons are composite bound-state structures consisting of pairs of the basic (spinor) particles (electrons or nucleons) that interact directly. It is concluded that deviations from the results of the usual field theories can be expected for processes in which the de Broglie wavelength of the colliding particles becomes comparable with the diameter of the photons or mesons (10^{-13} cm). Finally, a possible direct interaction and its relation to interaction expressions [Abstr. 2196 (1953)] are considered. W. A. HEPNER

530.145

4612. The mass relation of heavy particles. H. ENATSU. Letter in *Phys. Rev.*, **89**, 1304–5 (*March* 15, 1953).

Continuation and extension of previous work [Abstr. 7965–6 (1952)] to the case of heavy nucleons. A. O. STANESBY

530.145

4613. On the damping of virtual nucleon-pair formation in pseudoscalar meson theory. K. A. BRUECKNER, M. GELL-MANN AND M. GOLDBERGER. *Phys. Rev.*, **90**, 476–8 (*May* 1, 1953).

The modifications of the propagation characteristics of a nucleon which result from the presence of a strongly coupled mesonic self-field are estimated from the consideration of a simple subset of radiative corrections to the nucleon propagation function. It is found that reactive effects markedly inhibit nucleon pair formation so that the contributions from the pseudoscalar coupling term which do not involve nucleon pairs are strongly enhanced relative to those involving pair formation. In addition, the meson pair coupling term, which results from nonrelativistic approximations to the relativistic linear coupling term and is intimately connected with nucleon pair formation, is strongly damped. The relation of this result to the nonrelativistic theory of Wentzel is discussed. A.

530.145

4614. Effect of a short range repulsion on low energy singlet nucleon-nucleon scattering. M. H. HULL, JR, AND A. HERSCHMAN. *Phys. Rev.*, **90**, 482–94 (*May* 1, 1953).

Modifications needed in order that low-energy singlet scattering be described when a repulsive core is introduced in a phenomenological nucleon-nucleon interaction are investigated. It is found that if a square well is used to represent the attractive part of the interaction, a range of potential parameters allows a description of the data and also satisfies the charge independence hypothesis. When the Yukawa potential is investigated, the assumption of charge independence is more restrictive, and a single set of parameters is found. A.

530.145

4615. Fredholm theory of scattering in a given time-dependent field. A. SALAM AND P. T. MATTHEWS. *Phys. Rev.*, **90**, 690–5 (*May* 15, 1953).

It is shown that Feynman's relativistic solution for the scattering of an electron (or pair creation) by a given external field is the Fredholm resolvent of the related integral equation and is thus the unique and absolutely convergent solution for any strength of field. A.

530.145

4616. The construction of potentials in quantum field theory. K. A. BRUECKNER AND K. M. WATSON. *Phys. Rev.*, **90**, 699–708 (*May* 15, 1953).

An inductive method, based on the formal solution of the Schrödinger equation in the form given by Lippmann and Schwinger, is used to construct scattering potentials in quantum field theories of various types. The method is applied to a linear theory without nucleon pair production, to a general nonlinear theory without pair production, and finally to a general nonlinear theory with pair production. The nth-order potential is obtained by the solution of a Schrödinger type equation involving the potential of lower order; the series of potentials so obtained is, however, not a power series in the coupling constant. Rough estimates indicate that some of the problems of convergence associated with the usual perturbation expansion are obviated by this method. Simple illustrative examples are given for the linear and nonlinear theories. A.

530.145

4617. Theory of angular correlations. F. COESTER AND J. M. JAUCH. *Helv. phys. Acta*, **26**, *No.* 1, 1–16 (1953).

The most general angular correlation function may be written in the form $W = Tr(\varepsilon\rho)$, where ρ is the density matrix describing the ensemble of final nuclei and reaction products and the "efficiency matrix" ε is completely determined by the counter arrangement and the nature of the particles to be counted. Expansion of ε and ρ into sums of irreducible tensors greatly

simplifies the evaluation of the trace. Explicit general rules are derived for the construction of any angular correlation function from a few simple building stones. A.

530.145

4618. A differential equation for the Fermi scattering lengths in neutron-proton scattering. T. SEXL. *Acta phys. Austriaca*, **6**, *No.* 4, 329–31 (1953) *In German.*

Bergmann's differential equation for the phase δ_l (1950) is transformed into a 1st-order diff. equation for the scattering lengths. For a "square well" potential and $l = 0$ an exact solution is possible.

W. J. SWIATECKI

530.145

4619. Asymptotic eigensolutions of the radial deuteron equation. K. V. LAURIKAINEN. *Ann. Acad. Sci. Fennicae, A I, No.* 130, 10 *pp.* (1952).

Approximate solutions (valid for large k) of $\Phi'' - [k^2 + l(l+1)\,x^{-2} - be^{-x}x^{-1}]\Phi = 0$ are obtained by writing Φ as a product of its asymptotic value for large x times a function which is expanded in powers of $(2k + \text{const.})^{-1}$. Even for $k = 0$ an estimate for the eigenvalues is obtained (accurate to 25% for $l = 0$, 10% for $l = 1$). W. J. SWIATECKI

530.145

4620. Solution of perturbation equations. II. Form of the probabilities. M. FABRE DE LA RIPELLE. *C.R. Acad. Sci.* [*Paris*] **236**, 459–61 (*Feb.* 2, 1953) *In French.*

For Pt I, see Abstr. 3305 (1952). Discusses the time-dependence of the probability of finding an isolated physical system in a certain state and the condition that the form of the result obtained should also be valid after the approximations of perturbation theory. R. H. DALITZ

530.145

4621. Movable critical points of a nonlinear wave equation. T. TIETZ. Letter in *Phys. Rev.*, **90**, 495 (*May* 1, 1953).

It is shown that the ordinary differential equation governing solutions $\phi = f(s)$ $[s = t^2 - x^2]$ of the differential equation $(\partial_t^2 - \partial_x^2)\phi - \kappa^2\phi - \eta\phi^3 = 0$ always contains movable critical points. R. H. DALITZ

530.145

4622. Operational integrals and the extension of wave mechanics. F. DESTOUCHES-AESCHLIMANN. *C.R. Acad. Sci.* [*Paris*] **236**, 1140–2 (*March* 16, 1953) *In French.*

Using the definition of derivatives given elsewhere [Abstr. 4837 (1953)], it is possible to define integrals allowing the extension of wave mechanics to non-Hamiltonian systems. G. D. SIMS

530.162 : 532.51 : 536.7

4623. Statistical mechanics, thermodynamics, and fluid dynamics of systems with an arbitrary number of integrals. H. GRAD. *Commun. pure appl. Math.*, **5**, 455–94 (*Nov.*, 1952).

Classical statistical mechanics for a system with s degrees of freedom is generalized to include time-independent integrals, such as momentum and angular momentum, in addition to the energy. Call these integrals ε_i $(i = 1, 2, \ldots r \ll s)$: ε_1 is the energy, ε_2 the linear momentum, etc. Then a modified version of Khinchin's argument yields a generalized canonical distribution in phase space of the form $\exp(-\sum_i \alpha_i\varepsilon_i)/Z(\alpha_1, \ldots \alpha_r)$ where the α_i are "temperatures" (α_1 is $1/kT$). The function $S = \sum_i \alpha_i\varepsilon_i + \ln Z$ has properties analogous to those of entropy (e.g. the total "entropy" of bodies which can interact only with one another must increase) and thus a generalized version of thermodynamics is constructed. The formalism is applied to a perfect gas of point molecules possessing integrals of energy, linear momentum and angular momentum. It appears that the "temperatures" corresponding to linear and angular momentum are respectively the negative velocity and negative angular velocity, each divided by kT. For this simple case no new results appear, but if the molecules are given an internal structure, a new contribution to the energy comes from the molecular spin. This makes it necessary to postulate that the macroscopic action across a surface element in a fluid includes a couple tensor as well as the heat flow and an (asymmetric) stress tensor. The resulting new form of the conservation laws is combined with the entropy formula—assumed valid even away from equilibrium—to give, by the method of irreversible thermodynamics, a generalized viscosity law which includes an extra term associated with the rotation. An order-of-magnitude estimate shows that for gases the new effects are extremely small.

R. O. DAVIES

530.162 : 533.7

Boltzmann's equation in quantum mechanics. *See Abstr.* 4658

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.224 : 534.121.1

4624. The vibrations and bending of pre-stressed circular plates. E. LINDHOLM. *Ark. Fys.*, **6**, *Paper* 23, 223–42 (1953).

The vibration frequencies of a rotating circular plate which is pre-stressed near the centre and heated near the edge are calculated by an approximate variational method. The results are relevant to the stability of a circular saw at different speeds. The possibility of resonance associated with a transverse wave travelling backwards in the plate with the angular speed of the plate itself (i.e. stationary in space) is examined, with different numbers of nodal diameters. The deflection of a pre-stressed plate when simply supported at the ends of a diameter is also calculated, so that the amount of pre-stressing can be deduced from a simple static experiment.

J. G. OLDROYD

531.259.2 : 535.55

4625. Photoelastic determination of stresses in a cylindrical shell. H. FESSLER AND R. T. ROSE. *Brit. J. appl. Phys.*, **4**, 76–9 (*March* 1953).

The frozen stress photoelastic technique is used to determine the surface stresses and deformations of a cylinder with flat disk head (2·7 in. bore, 0·380 in. wall thickness) under internal pressure. The material

used was Marco Resin SB.26.C; the technique of casting, machining, freezing and slicing of the models is described. The observed stresses and deformations are compared with values calculated from an analysis by Watts and Burrows (1949) and found to be in fair agreement except near the juncture of head and shell.

A.

531.32

4626. On the motion of a point mass in a resisting medium of variable density. E. LEIMANIS. *Acta phys. Austriaca*, **6**, *No.* 4, 319–21 (1953) *In German.*

A solution in closed form is obtained for the equation $\ddot{z} = g(z) - k\dot{z}^{-2}e^{az}$. This extends Sexl's results [Abstr. 2437 (1952)] to the case of variable gravity and resistance varying inversely as the square of the velocity.

R. A. NEWING

531.38 : 539.18 : 539.4 : 541.18.043

4627. Some scientific applications of high speed-rotation. P. B. MOON. *Brit. J. appl. Phys.*, **4**, 97–101 (*April*, 1953).

A general account is given of scientific uses of rotary apparatus, including high-speed shutters for neutrons, Doppler effect measurements with γ-rays and work with molecular beams. Classical applications are briefly mentioned, and the principles of rotor design are discussed.

A.

MECHANICAL MEASUREMENTS 531.7

531.717 : 535.345 : 537.531

Measurement of thicknesses up to 10 mm with X-rays and Geiger counter. *See Abstr.* 4827

531.717.7

4628. Accuracy of spherometer measurements. E. HEINEMANN. *Optik*, **9**, *No.* 11, 525–6 (1952) *In German.*

The results of Schulz [Abstr. 5568 (1952)] are confirmed and re-arranged to give a more convenient practical formula for the correction to the radius measured with a spherometer.

R. W. FISH

531.724 : 541.123.5

4629. Determination of surface area of a powder by the ion exchange method. V. MILUTINOVIĆ AND S. NOVAKOV. *Recueil Trav. Inst. Rech. Struct. Matière* [*Belgrade*] **1**, 107–10 (*July*, 1952).

Powders of $PbCl_2$, AgCl and Hg_2Cl_2, obtained by precipitation of nitrates with KCl, were made to react with a KI solution, and the course of the ion-exchange reactions was followed either by direct titration or by using I_{53}^{128} as indicator. The numbers of atom [lattice] layers taking part in the exchange reaction were calculated from the equilibrium data for specimens with known surface areas, and the following numbers were obtained: $PbCl_2$, 1700; AgCl, 1600 and Hg_2Cl_2, 250. These figures enable, conversely, the surface area of powders to be determined from equilibrium data.

F. LACHMAN

531.756 : 539.155.2

4630. Determination of low concentrations of heavy water. V. VUKANOVIĆ AND B. PAVLOVIĆ. *Recueil Trav. Inst. Rech. Struct. Matière* [*Belgrade*] **1**, 103–6 (*July*, 1952) *In French.*

A magnetic-swimmer apparatus, enabling small differences in the density of water to be determined, has been used for the determination of relative amounts of D_2O (or D) in (1) the water of crystallization of $K_2Al_2(SO_4)_4 . 24H_2O$, (2) beer and (3) malt. The apparatus requires 1 cm³ of liquid and is claimed to give results accurate to 4×10^{-6} g/cm³ of D_2O ($\sim$0·004%). Slightly greater D_2O contents have been detected in the substances tested than in standard water.

F. LACHMAN

531.765 : 537.542 : 621.317.39

4631. On a method of measuring very small time intervals. A. SUSZKIN. *J. Madras Inst. Technol.*, **1**, 137–41 (*Aug.*, 1952).

The system uses three spark counters and associated quenching circuits [Abstr. 2990 (1949)] arranged in the path of ionized particles. The first two are some metres apart, the third very close to the second, and their load resistors are connected to a c.r.t. containing special retarding electrodes. Counter 1 strikes and a potential is applied to the retarding electrodes and the deflector plates; at counter 2 the cut-off grid of the tube is released and the beam starts, is retarded by the special electrodes and finally strikes the screen at a point determined by the potential of the deflector plates and the beam velocity, both being controlled by the particle time of flight (say, 10^{-8} sec) due to the time constant of the circuits. At counter 3 the further deflection of the beam is arrested so that the spot shift can be measured. This shift corresponds to a time about 100 times that to be measured (so-called "time magnification") and can be more easily determined.

E. D. HART (R)

531.781 : 621.317.79

4632. An instrument for measuring small forces. R. GIBSON, J. INGHAM AND L. J. POSTLE. *J. sci. Instrum.*, **5**, 159–62 (*May*, 1953).

Describes an instrument suitable for measuring forces over a range from 10 to 12 000 mg weight with a frequency response which is substantially linear up to 100 c/s. The force is applied to the centre point of a diaphragm which forms one plate of a parallel-plate condenser in one arm of a h.f. bridge circuit. The off-balance voltage produced by the variation in capacitance of the condenser is amplified, rectified and displayed on a c.r.t. Some details of the performance of the instrument are given in the final section.

A.

MECHANICS OF FLUIDS 532

532.13

4633. A viscosity difference between ortho and para-hydrogen at low temperatures. E. W. BECKER AND O. STEHL. *Z. Phys.*, **133**, *No.* 5, 615–28 (1952) *In German.*

The effect of the para-hydrogen content on the viscosity of H_2 was detected experimentally and measured in the temperature range from 15 to 90°K with a relative accuracy of $\pm$5%. A mixture with a higher p–H_2 content had always a greater viscosity.

The experimentally determined difference for the effective cross-section of *p–p*, *o–p* and *o–o* collisions seems to be due to the dynamic difference between the H_2 modifications (a *p*-molecule rotates in the ground state, while an *o*-molecule does not). No kinematic effect [Halpern and Gwathmey, *Phys. Rev.*, **52**, 944 (1937)] could be observed. F. LACHMAN

532.14

4634. Some physical properties of uranium hexafluoride. D. R. LLEWELLYN. *J. Chem. Soc.*, **1953**, 28–36 (*Jan.*).

A number of physical constants of uranium hexafluoride are determined. The density of the liquid was measured between 65° and 100° and that of the vapour from 0° to 100°. The specific heat was determined from −60° to +100° and the data were used, together with the vapour-pressure measurements from −15° to +100°, to calculate a vapour-pressure equation for solid and liquid. The critical temperature, melting point and heat of melting are recorded. The viscosity, surface tension and refractive index of the liquid were measured between 65° and 100°. The thermal conductivity of the vapour was measured at 5° and 105°, and the viscosity over a temperature range 0–200°. The heat of vaporization of solid and liquid, Sutherland's constant, the mean free path, the parachor and the molecular refraction have been calculated. A.

532.5

4635. The maximum velocity in Gromeka–Beltrami motion. C. TRUESDELL. *R.C. Accad. Naz. Lincei*, **13**, 378–9 (*Dec.*, 1952) *In Italian.*

Mathematical. By the use of Bernoulli's equation, Bouligand's theorem (1926) has been extended and applied to the maximum velocity in the case of stationary, irrotational motion under zero external force. This form of the theorem is now extended to the case of Gromeka–Beltrami motion. S. WEINTROUB

532.5

4636. The Dirac function and an elementary problem in hydrodynamics. S. BILINSKI. *Period. math.-phys. astron.* [*Zagreb*] **7**, *No.* 4, 219–25 (1952) *In Serbo-Croat. Summary* (2 *pp.*) *in German.*

For a liquid at rest the contribution of each part of the liquid to the hydrostatic pressure at a given point is considered. For the particular model of hard sphere molecules, the pressure below a given molecule reduces to a δ-function distribution for molecules of negligible diameter. R. H. DALITZ

532.51

4637. Note on hydrodynamics. C. DARWIN. *Proc. Cambridge Phil. Soc.*, **49**, *Pt* 2, 342–54 (1953).

A study is made of the actual trajectories of fluid particles in certain motions of classical hydrodynamics. When a solid body moves through an incompressible fluid, it induces a drift in the fluid, such that the final positions of the particles are further on than those from which they started. The drift-volume enclosed between the initial and final positions is equal to the volume corresponding to hydrodynamic mass, that is, the mass of fluid to be added to that of the solid in calculating its kinetic energy. This result is proved quite generally. The work involves integrals which are not absolutely convergent, and these are discussed in relation to the general mechanics of fluids. When the trajectories of the fluid surrounding a rotating body are considered, it is shown that the fluid particles slowly drift round the body, even though the motion is irrotational and without circulation. There seems to be in some respects a closer resemblance between the behaviour of the idealized hydrodynamic fluid and a real fluid than might be expected from the well-known discrepancies between them. A.

532.51 : 523.877 : 538.3

Generalized magneto-hydrodynamic formulae. *See Abstr.* 4919

532.51 : 536.7 : 530.162

Statistical mechanics, thermodynamics, and fluid dynamics of systems with an arbitrary number of integrals. *See Abstr.* 4623

532.517

4638. On the flow between two rotating coaxial disks. K. STEWARTSON. *Proc. Cambridge Phil. Soc.*, **49**, *Pt* 2, 333–41 (1953).

The steady motion of a viscous fluid confined between two coaxial rotating disks is discussed both experimentally and theoretically. It is found experimentally that when the disks rotate in the same sense the main body of the fluid rotates as well, but if they rotate in opposite senses the main body of the fluid is almost at rest. An adequate theory is found to explain this. A.

532.517.3 : 532.51

4639. The transition [to turbulent flow] in the flow of incompressible fluid along a plane. G. VIGUIER. *Bull. Acad. Roy. Belgique Cl. Sci.*, **38**, *No.* 11, 1055–9 (1952) *In French.*

The equation governing velocities in the transition zone from laminar to viscous flow of incompressible flow along a plane, is established on the assumption that the tangential viscous friction, in place of being given by the classical expression $f = \mu\, du/dx$, is given by $f = \mu\, du/dx + D(du/dx)^3$, du/dx denoting the transverse velocity gradient in the flow.

J. S. G. THOMAS

532.58

4640. The couple on a rotating spheroid in a slow stream. L. SOWERBY. *Proc. Cambridge Phil. Soc.*, **49**, *Pt* 2, 327–32 (1953).

The problem considered here is to determine the couple required to maintain the steady rotation about its axis of symmetry of an oblate spheroid which is placed in a uniform stream of viscous fluid moving parallel to this axis. The conditions of flow are assumed to be such as to permit the use of Oseen's approximation in the equations of motion. An expression in terms of spheroidal wave functions is derived for the transverse component of velocity in the fluid, and from this the expression for the couple is deduced. The disk rotating about the normal through its centre is considered as a special case, and some numerical results are given for certain values of a Reynolds number. A comparison is made, and agreement found, with results obtained by Jeffery in a previous paper (1914) which treated the case in which the mainstream was at rest. A.

MOLECULAR THEORY OF LIQUIDS 532.7

532.7

4641. Space requirements and coefficients of activity of strong electrolytes in aqueous solution. E. WICKE AND M. EIGEN. *Z. Naturforsch.*, **8a**, 161–7 (*Feb.–March*, 1953) *In German.*

Discusses the analogy between the variation of the coefficient of activity with concentration and the behaviour of real gases. An expression is derived for the distribution of strongly hydrated ions in the ionic cloud, which takes into account the effect of the mutual spatial displacement. The distribution function is based on the assumption of partial penetration of hydrate shells of the ions of opposite signs. If this function is substituted for the simple Boltzmann distribution in the theory of Debye–Hückel, it becomes possible to portray accurately the variation of the coefficient of activity with concentration. This is shown for the 1–1, 1–2 and 1–3 electrolytes. If the empirical constant a used in the calculations is construed as the "average hydration radius," its values agree with other hydration data. F. LACHMAN

532.71 : 536.7 : 537.362

4642. The thermomechanics of transport phenomena. J. E. VERSCHAFFELT. *Recueil Trav. chim. Pays-Bas*, **71**, 705–16 (*July*, 1952) *In French.*

As a further illustration of the author's claim that the "superposition principle" is equivalent to the use of the Onsager theorem, formulae are developed to deal with osmotic transfer. R. O. DAVIES

532.71 : 536.7 : 537.362

4643. The thermomechanics of transport phenomena. J. T. G. OVERBEEK AND P. MAZUR. *Recueil Trav. chim. Pays-Bas*, **71**, 717–18 (*July*, 1952) *In French.*

Verschaffelt's formula for the electro-osmotic effect (preceding abstract) is shown to be in disagreement with experiment. R. O. DAVIES

532.712 : 541.24

4644. The determination of molecular weights of macromolecules from measurements of osmotic pressure. E. A. GUGGENHEIM AND M. L. MCGLASHAN. *Trans Faraday Soc.*, **48**, 206–11 (*March*, 1952).

A new method of analysing osmotic pressure measurements on solutions of non-polar macromolecules in non-polar solvents is described. The method is applied to the measurements of Bawn and others on solutions of polystyrene in toluene. The estimates so obtained for molecular weights differ from those of Bawn. A.

532.72 : 536.2 : 541.124

4645. Distribution of matter and the transport phenomena in the presence of a temperature gradient, and chemical reactions. I. PRIGOGINE AND R. BUESS. *Bull. Acad. Roy. Belgique Cl. Sci.*, **38**, *No.* 7, 711–17; *No.* 8–9, 851–60 (1952) *In French.*

Discusses the effect of a temperature gradient on the distribution of matter and transport phenomena in systems of two reacting constituents (different energy states of a chemical substance, isomers, etc.). Even in a stationary state, different changes take place in such a system (diffusion, energy transport, mutual transformation of constituents). Discusses the general form of expression for the heat flow and points out that, besides thermal conductivity, it contains a term of "internal convection" related to the transport of the heat of reaction. Develops expressions for evaluating this effect in condensed phases. A system with two reacting and one non-reacting constituent is next studied, in particular the effect of the heat of reaction and coefficients of thermal diffusion on stationary distribution. Results are applied to thermal diffusion of an associated constituent (e.g. CH_3COOH) in an inert solvent. Experimental data available confirm one of the theoretical results, viz. that, in sufficiently diluted solutions, the colder portions of the system contain more of the associated constituent. F. LACHMAN

532.739.2 : 548.5

4646. The solubility of silicon and germanium in gallium and indium. P. H. KECK AND J. BRODER. *Phys. Rev.*, **90**, 521–2 (*May* 15, 1953).

The solubilities of silicon and germanium in liquid gallium and in indium were determined over a wide temperature range. If the logarithms of the solubilities are plotted against the inversed absolute temperatures, straight lines are obtained, the slopes of which yield the heats of solution. For the investigated systems it was found that the heats of solution are approximately proportional to the third power of the radii of the solvent atoms. Upon slow cooling of the saturated solutions silicon and germanium crystals of fair purity were obtained. The solubility data are of interest for the preparation of junction transistors. A.

532.74

4647. Activity data and the association of hydrogen chloride in concentrated solutions. A. M. POSNER. Letter in *Nature* [*London*] **171**, 519–21 (*March* 21, 1953).

The observed values of the activity coefficient of HCl in solutions >4N are less than those calculated from the known semi-empirical relationship. Assuming that the deviations are due to association (true, or into an ion pair), the value of the association constant extrapolated for $c = 0$ is found graphically to be 0·056, in reasonable agreement with values calculated under certain assumptions from the activity coefficients observed at 0°, 20° and 50°C, for concentrations between 5N and 10N. The figure of $K_{c=0}$ for HNO_3, obtained by light absorption experiments [Redlich and Bigeleisen, *J. Amer. Chem. Soc.*, **65**, 1883 (1943)] is $0{\cdot}05 \pm 0{\cdot}01$. The association of HCl in concentrated solutions is confirmed by the variation of the heat of formation of solution of HCl with concentration. F. LACHMAN

532.74 : 539.11 : 536.71

Fusion as order-disorder transition. *See Abstr.* 4779

MECHANICS OF GASES 533

533.15 : 536.23

4648. Thermal diffusion in gases. K. E. GREW AND T. L. IBBS. *Cambridge: The University Press* (1952) xi + 143 *pp.* [*Cambridge Monographs on Physics*].

After reviewing the qualitative aspects of the kinetic

theory of gases as it applies to thermal diffusion, including the recent development of Hirschfelder, Bird and Spotz [Abstr. 480, 3019 (1949)] based on the Lennard–Jones molecular model, Grew and Ibbs discuss experimental methods applicable to measurements of the thermal-diffusion coefficients for gaseous systems. These involve various physical methods of analysis that produce no disturbance of the diffusion components. Alternatively, the temperature rise accompanying interdiffusion of two gases can be determined (the Dufour effect) and the thermal diffusion constant for the mixture computed. Although the concentration difference that can be produced in a binary gas mixture by application of a temperature gradient to a stationary mixture is only about 3 mole % in the most favourable case (H_2–N_2) for a temperature difference of 100°C, nearly complete separations of isotopic mixtures, such as HCl^{35} and HCl^{37}, have been obtained in an apparatus employing natural convection circulation to obtain counter-current contact between cold and hot (heavy and light) streams. Conditions of optimum operation of such equipment are discussed. The book concludes with a short survey of thermal diffusion in liquids, sometimes called the Soret effect. Here a theoretical development is largely lacking. The extremely slow rate of attainment of separation equilibrium, owing to the very low coefficients of ordinary diffusion in liquids, is the principal deterrent to practical application. APPLIED MECHANICS REVIEWS

533.15

4649. Remarks on H. Mache's method for the determination of the diffusion coefficient of air in water. F. BRANDSTAETTER. *S.B. Österr. Akad. Wiss IIa*, **161**, *No.* 4–6, 107–30 (1952) *In German.*

H. Mache's gas bubble method for the quick determination of the d.c. of gases in liquids [*Akad. Wiss. Wien, Ber.*, **138**, 529 (1929)] gave an apparent dependence of the d.c. on the bubble radius. In the present paper it is shown by systematic experiments that this dependence is probably due to a surface effect as the transfer of the gases through the bubble surface is influenced by the unavoidable presence of solutes. H. LONDON

533.5

4650. Experimental investigations on some high vacuum systems. J. LONČAR. *Period. math.-phys. astron.* [*Zagreb*] **7**, *No.* 4, 197–215 (1952) *In Serbo-Croat. Summary* (3 *pp.*) *in English.*

Construction of Hickman type oil diffusion pumps and of the gauges required for low and high vacua is described. With Apiezon oil, silicone fluid and Octoil (di–2–ethyl-hexylphthalate) as pumping fluids, pumping speeds were estimated to reach 10 litres/sec. The vacua obtained were satisfactory (0·012 μHg) for work in electronics for which the pumps had been designed. G. WITTENBERG

533.5

4651. Combined Pirani and ionization gauge circuit. G. VON DARDEL. *J. sci. Instrum.*, **30**, 114–17 (*April*, 1953).

The construction of a combined Pirani and ionization gauge vacuum-meter is described. The Pirani gauge is of the constant temperature type with a working range of 10^{-3} to 10 mm of mercury. As a leak detector it may be used even at atmospheric pressure or higher. A relay circuit actuated by the gauge protects diffusion pumps and other equipment in case of vacuum failure. The emission current of the ionization gauge is held constant within 3% during the entire tube life by a stabilizer. The ion current is measured by a simple vacuum tube voltmeter. The ionization gauge is operated by a single master switch.

533.6.01

4652. A composite distribution of velocities due to molecular agitation. J. J. BERNARD. *R.C. Accad. Naz. Lincei*, **14**, 46–50 (*Jan.*, 1953) *In French.*

The unlimited, stationary uni-dimensional flow of gas, such that beyond certain limits upstream and downstream the flow is assimilable to uniform movements defined in terms of the density, mean velocity and temperature of the stream, is discussed mathematically; the gas is considered to be composed of a single type of molecule such that only translatory velocities are involved in exchanges of energy associated with shocks. The distribution of velocities of molecular agitation is Maxwellian. An integral expression is given for the composite velocity distribution discussed, and expressions are given for (1) the number of molecules contained in a section, (2) the mean kinetic energy of agitation whence a value of h, the Maxwellian constant, is derived, (3) stresses in the fluid and (4) the flux of heat. The velocity distribution is applied to discuss Boltzmann's equation, and it is concluded that this equation can be resolved by customary methods of linearization and successive approximation. J. S. G. THOMAS

533.6.01 : 536.24

4653. Basic methods in transfer problems. V. KOURGANOFF. *London: Oxford University Press*, xv + 281 *pp.*

Review in *Brit. J. appl. Phys.*, **4**, 94 (March, 1953).

533.6.011

4654. Tables and approximate formulae for hypergeometric functions, of high order, occurring in gas-flow theory. T. M. CHERRY. *Proc. Roy. Soc. A*, **217**, 222–34 (*April* 8, 1953).

The tables give essentially (i.e. apart from normalization factors) the hypergeometric functions which arise in the hodograph method for calculating steady flows of a gas whose adiabatic exponent γ is 1·4. Calling τ the argument and ν the order of these functions, the range covered is $\tau = 0{\cdot}08(0{\cdot}02)0{\cdot}30$, $\pm\nu = 10{\cdot}5(1{\cdot}0)30{\cdot}5$, with 6 significant figures for the smaller $|\nu|$ and 4 for the higher. Regarding τ, this is the trans-sonic range, for which elementary asymptotic formulae are not available. Convenient approximate formulae also are given, whereby the tables can (if necessary) be extended to much higher values of $|\nu|$. A.

533.6.011.3

4655. Determination of the velocity field of a plane subsonic flow. L. MARCHETTI. *R.C. Accad. Naz. Lincei*, **14**, 42–6 (*Jan.*, 1953) *In Italian.*

A formula is developed which, if the lines of flow are known, allows the calculation of the velocity along any line. L. PINCHERLE

533.6.011.3

4656. D'Alembert's paradox and the moment formula in three-dimensional subsonic flow. G. S. S. Ludford. *Rev. Fac. Sci. Univ. Istanbul A*, **18**, 1–13 (*Jan.*, 1953).

The disturbed motion produced by the introduction of a body into a uniform stream of perfect inviscid compressible fluid is investigated under the assumptions that the resulting flow is irrotational and devoid of discontinuities extending to infinity. The form of the expansion of the potential function at large distances is shown to be similar to that for the incompressible case. Knowing this result it is possible to calculate the first few terms of the expansion, and hence to show that the force on the body is zero (D'Alembert's paradox) and that the moment is perpendicular to the undisturbed stream. A.

533.6.011.5

4657. On boundary layers and upstream influence. I. A comparison between subsonic and supersonic flows. M. J. Lighthill. *Proc. Roy. Soc. A*, **217**, 344–57 (*May* 7, 1953).

It is pointed out that there are two separate mechanisms for upstream influence through the boundary layer in supersonic flow, and that one of these (that involving separation) operates also in subsonic flow. A quantitative theory of subsonic flow up a step is given to illustrate this. The main differences between the subsonic and supersonic flows are as follows: (i) The boundaries of dead-air regions are nearly straight in supersonic flow but are usually highly curved in subsonic flow. (ii) Separation (whether of the laminar or turbulent layer) occurs at a much lower pressure coefficient in supersonic flow; this is only slightly due to the fact that the fluid nearest the wall is then lighter and so more easily brought to rest; it is due much more to the relative suddenness of the pressure rise ahead of the dead-air region. (iii) However, for a given pressure coefficient in the dead-air region, the distance of upstream influence is somewhat greater in the subsonic flow, except at the highest pressures. A qualitative discussion of the second mechanism of upstream influence, in supersonic flow, is given. A.

MOLECULAR THEORY OF GASES 533.7

533.7 : 530.162

4658. Boltzmann's equation in quantum mechanics. H. S. Green. *Proc. Phys. Soc.* [*London*] *A*, **66**, 325–32 (*April*, 1953).

This note gives a rigorous derivation of the quantum-mechanical analogue of Boltzmann's equation in gas theory. Assuming that the incidence of multiple encounters, other than binary encounters, between the molecules can be neglected, a closed equation for the phase space distribution of pairs of molecules is derived. The formulation of a boundary condition for this equation requires an independent appeal to statistical principles, and is the only point at which irreversibility enters the theory. A solution of the equation is given which satisfies the boundary condition. Corrections to Boltzmann's equation, which are of quantum-mechanical as well as classical origin, are derived for slightly dense gases. A.

533.75

4659. A quantum correction to the Lennard-Jones and Devonshire equation of state. S. D. Hamann. *Trans Faraday Soc.*, **48**, 303–7 (*April*, 1952).

The lighter gases are known to deviate from the Lennard-Jones and Devonshire (LJD) equation of state and from the principle of corresponding states. These deviations are explained in terms of the quantization of translational motion within the individual molecular cages. The corrected LJD isotherms for helium at low temperatures and high densities agree well with the experimental data. A.

533.75 : 539.13

4660. The second virial coefficients of some organic molecules. S. D. Hamann and J. F. Pearse. *Trans Faraday Soc.*, **48**, 101–5 (*Feb.*, 1952).

A differential method has been applied in determinations of the second virial coefficients $B(T)$ of some organic gases. The results show that the method admits of considerable accuracy. The adequacy of some simplified representations of the interaction fields between molecules has been considered in the light of the present results and of earlier data. The Stockmayer treatment of $B(T)$ for dipolar gases yields parameters that fail to show the expected dependence upon molecular dimensions. A simple model has been shown to describe quite well the interaction of complex non-spherical non-polar molecules. A.

VIBRATIONS . ACOUSTICS 534

534.121.1 : 531.224

The vibrations and bending of pre-stressed circular plates. *See Abstr.* 4624

534.132

4661. The physics of the organ flue pipe. D. M. A. Mercer. *Amer. J. Phys.*, **21**, 376–86 (*May*, 1953).

A review article in which the physical principles underlying the function of the organ flue pipe are considered. Many of the points are not understood, and attention is called to them as possible lines of investigation. A survey is made of the various theories of the action of the airstream at the mouth of the pipe; details are given of the variations in construction and their effect on the tone. Finally attention is paid to the tones of organ pipes in combination, and the conditions for a satisfactory musical effect are outlined. A.

534.154 : 521.318.38

4662. Electromagnetic vibration pick-ups with simple seismic suspension. J. A. Macinante *J. sci. Instrum.*, **30**, 155–8 (*May*, 1953).

Describes two types of electromagnetic vibration pick-up, in which the seismic element consists of a cylindrical permanent-magnet held between a pair of flat parallel steel strips. Two coils of fine wire

are located in the radial field at the poles of the magnet. When the pick-up is held on a vibrating object an electromotive force is generated in the coils and the characteristics of the vibration may be studied in terms of the wave form of this e.m.f., as displayed on an oscilloscope. With this arrangement the output e.m.f. is proportional to velocity for small amplitudes, and the damping is very small. The pick-up Type 1 weighs 340 g and has an output of $1 \cdot 1$ V/in.sec^{-1} within the normal operating range. The natural frequency of the suspension is $3 \cdot 2$ c/s in the horizontal arrangement and $6 \cdot 3$ c/s in the vertical. The pick-up Type 2 weighs 100 g and was designed for lightness and for the convenient detection of the vertical or any horizontal component at a given point. The output is $0 \cdot 2$ V/in.sec^{-1} and the natural frequencies $5 \cdot 8$ and $6 \cdot 4$ c/s in the horizontal and vertical arrangements respectively. The limit of amplitude is $0 \cdot 1$ in. for Type 1 and $0 \cdot 08$ in. for Type 2. The minimum working frequency is about 6 c/s (horizontal) and 12 c/s (vertical) for Type 1, and 12 c/s (horizontal or vertical) for Type 2. The pick-ups were designed and have been used only for frequencies < 100 c/s, but should be suitable for much higher frequencies. Simple formulae of sufficient accuracy for the calculation of the natural frequencies for design purposes are derived. A.

534.22 : 532.12

4663. Ultrasonic velocity and adiabatic compressibility of hydrocarbon mixtures. F. Danusso. Note in *R.C. Accad. Naz. Lincei*, **13**, 131–8 (*Sept.–Oct.*, 1952) *In Italian.*

See Abstr. 6065 (1951). The densities ρ and velocities u (at 4 Mc/s) of all the possible binary mixtures of *n*-heptane, cyclohexane, benzene, cetane and decaline, and, in addition, of the mixture of hexane and paraffin oil, have been measured at 30°C. The values obtained for ρ and u together with B, the molecular compressibility, and the molar volume V as a function of x the molar fraction, are tabulated and discussed. The deviations ΔV, etc., of these quantities from those of the ideal athermic case considered theoretically are shown graphically. The systems fall into three groups (*a*) contraction in V and increase in u (with corresponding decrease in B), (*b*) expansion in V and decrease in u (with corresponding increase in B) and (*c*) expansion in V and increase in u. It is concluded that the theory for athermic mixtures is verified experimentally for the cetane-decaline system for which the deviations are zero within the experimental error, that the maximum percentage deviations in V, u and B occur at the same x which is characteristic of the particular system, and that to a first approximation $\Delta u/u$ is proportional to $\Delta V/V$ and to $\Delta B/B$. S. WEINTROUB

534.22 : 532.7

4664. Measurements of the velocity of sound in some liquefied gases. L. Verhaegen. *Verhandl. K. Vlaamse Acad. Wetensch.*, **13**, *No.* 38, 65 *pp.* (1952) *In Flemish.*

The molecular radius is calculated by Schaafs' method [*Z. Phys*, **114**, 110 (1939) and **115**, 69 (1940)] and the kinetic theory of Kittel [Abstr. 561 (1947)] is used. A description is given of the ultrasonic interferometer used and of the electrical equipment. Measurements have been made in O, N, A, CH_4 (with a special apparatus for varying the pressure of the electrodes on the quartz crystal) and H (with a special condensation apparatus). For H the velocity is dependent on the concentration ratio of ortho and para hydrogen, influenced by the applied field. The compressibilities, molecular radius and degree of association are calculated. The change in velocity as a function of absolute temperature is linear for these liquid gases, and is larger than for organic compounds. C. TURNER

534.22 : 532.7

4665. Ultrasonic velocity and adiabatic thermodynamic property of liquid organic compounds. F. Danusso and E. Fadigati. *R.C. Accad. Naz. Lincei*, **14**, 81–8 (*Jan.*, 1953) *In Italian.*

See Abstr. 4150 (1951). Values of u, the ultrasonic velocity at 4 Mc/s, β, the adiabatic compressibility and ϕ, the adiabatic change in internal energy per mole per atm. are tabulated for water between 0–80°C and for 40 organic liquids at 30°C, together with values of ρ the density, in addition to values of ρ and u at various temperatures for 10 particular liquids. The low value of the temperature coefficient of u for the alcohols is attributed to the strongly associated structure. From the above data and those of other authors, the values of $D_2 = u^{\frac{1}{2}}(M/\rho)$, where M is the molecular mass, are calculated for the various atomic groups and their significance is briefly discussed. S. WEINTROUB

534.23

4666. Ultrasonic attenuation measurements in germanium. R. Truell and J. Bronzo. Letter in *Phys. Rev.*, **90**, 152 (*April* 1, 1953).

Single crystals with various histories were examined over a frequency range from 15 to 100 Mc/s. The results show large differences between the samples caused both by heat treatment and by impurities deliberately introduced. It is believed that such measurements will enable relative amounts, or numbers, of defects present, to be obtained.

G. F. HODSMAN

534.23 : 532.77

4667. Propagation of ultrasonics in systems of partially mixed liquids. S. Petralia and M. Cevolani. Note in *R.C. Accad. Naz. Lincei*, **12**, 674–82 (*June*, 1952) *In Italian.*

An experimental investigation in the binary liquid systems, phenol and water, and aniline and cyclohexane, of the variation with temperature of the velocity of propagation and of the attenuation of ultrasonic waves (at 3 Mc/s) with particular reference to the critical states of the solutions. Brief details are given of the experimental arrangement and of the methods used. The velocity in liquid phenol, measured over the range 46–80°C, decreased linearly from $1433 \cdot 3$ m/sec at 46°C by $3 \cdot 0$ m/sec per °C. The results for the binary systems are tabulated and shown graphically. The velocity changes discontinuously and the attenuation increases markedly, in both systems, at the critical solution temperature.

S. WEINTROUB

534.232 : 537.228.1

4668. On the study of the wave field of a vibrating quartz crystal. C. Ener. *Rev. Fac. Sci. Univ. Istanbul A*, **18**, 101–9 (*Jan.*, 1953).

Using a spark of very short duration (about 10^{-7} sec) as a high intensity light source, and applying different potentials on the quartz crystal, the wave field of a 2×2 in. X-cut crystal of $f = 1000$ kc/s, in water, has been studied, spark-shadowgram pictures have been taken and the wave field of the crystal described. A.

534.24 : 535.3 : 535.42

4669. The wave field in front of a concave mirror. G. Joos. *Optik*, **9**, *No.* 12, 544–5 (1952) *In German.*

Standing acoustic waves have been photographed, the waves being produced by the reflection of a plane wave at a concave cylindrical mirror. The separation of the nodes near to the focus lends support to the theoretically calculated anomalous propagation of phase. H. H. HOPKINS

534.61

4670. Acoustic measurements on automobile horns. *Brüel & Kjær tech. Rev., No.* 2, 16 *pp.* (*April*, 1953).

Suitable measuring equipment for acoustic tests on auto-horns is briefly described. The conditions of quality for auto-horns are laid down, and in the case of three different types of cars measurements have been carried out on the car's sound insulation as a function of frequency, on the horn's sound intensity and frequency composition and the sound's distribution characteristic in both horizontal and vertical direction, as well as the difference in sound intensity between the outside and the inside of the car. A.

534.62

4671. Measurement of the absorption coefficients of sound. T. Vogel. *Ann. Télécomm.*, **8**, 93–6 (*March*, 1953) *In French.*

The author first discusses the complexity of the problem involved in the measurement of absorption coefficients and time of reverberation, and then outlines a method in which the conditions of measurement are previously stated. He uses the terms "specific normal impedance" and "specific tangential impedance" of the material and discusses the results based on Rayleigh's theory. It then becomes possible to obtain a mean absorption coefficient, useful in calculating reverberation time, by a measurement at a single angle of incidence. A. B. WOOD

534.7 : 612.85

Physiological acoustics. Hearing. *See Abstr.* 5261–2

534.844 : 534.862.3/.4

4672. A review of reverberation times of sound-recording and reproducing rooms in Berlin. H. Dippner and H.-J. Zemke. *Frequenz*, **7**, 71–81 (*March*, 1953) *In German.*

The difference between the acoustics and the audibility or subjective qualities of public rooms is stressed. The reverberation time alone cannot define the subjective qualities, which depend upon the age, sex, concentration, and previous conditioning of the subject. The visual observation of the speakers or players, too, may partially compensate for acoustic shortcomings. Furthermore, all calculations of reverberation time must necessarily be approximations, a fact which makes the checking of this quantity during construction of a hall essential. In an attempt to collect useful design data, not only the reverberation times—in the form of frequency characteristics—but also the descriptions, volumes, capacities, and ages are given for over 50 halls and photographs of 14 of them are appended. Halls generally are divided into four classes; (1) rooms for direct speech and music presentation, such as churches, theatres, opera houses, lecture, concert and entertainment halls; (2) recording studios, both film and broadcast; (3) reproducing rooms including cinemas and control studios, and (4) general-purpose rooms. The characteristics and requirements of each type are studied in some detail. H. G. M. SPRATT

534.845 : 621.396.712.3

4673. Membrane sound absorbers and their application to broadcasting studios. C. L. S. Gilford. *B.B.C. Quart.*, **7**, *No.* 4, 13–23 (1952–53).

Commercially available sound absorbers consist of porous materials very efficient over most of the audio range but ineffective below 200 c/s. The absorbers described are very efficient and have an absorption coefficient between 0·8 and 1·1 between 50 and 250 c/s, depending on the construction. The absorber consists of a framework of several square feet area attached to a wall or other surface and enclosed at the sides by some inexpensive sheet material. The front is closed in by the membrane of ordinary bitumen roofing felt. A blanket of rockwool or other loose material may be hung behind the membrane. The resonant frequency (f_r) depends on a large number of variables, including the membrane size, spacing from the wall, etc. Formulae are developed for calculating the resonance and numerous curves given showing the variation of the absorption coeff. over a range from 50–1000 c/s. Generally the value of coeff. at f_r is about five times that over the remainder of the range and the bandwidth about 50% of the f_r. The method of measuring absorption is described and photos showing the application in studios are given. B. B. AUSTIN (R)

534.846.6

4674. Measurement of the reflection of ceilings by means of ultrasonics. F. Canac. *C.R. Acad. Sci.* [*Paris*] **236**, 467–9 (*Feb.* 2, 1953) *In French.*

The effectiveness of ceilings containing recesses and cavities for reducing reverberation and reflection is verified by means of reduced scale models, using a stroboscopic method. Some examples of results obtained are given. G. F. HODSMAN

534.88 : 59

4675. Porpoise sounds as sonar signals. W. N. Kellogg, R. Kohler and H. N. Morris. *Science*, **117**, 239–43 (*March* 6, 1953).

Porpoises were suspected of possessing echo-location powers for orientation and navigation and accordingly tests were carried out to determine whether they emit the sonic or ultra-sonic signals necessary for this purpose. An under-water Rochelle-

salt hydrophone with a 2-stage head amplifier was used as a detector. The output was then fed through further amplifiers to a tape recorder of the telemetering type with a frequency range extending beyond 0·1 Mc/s. Three methods of frequency determination were used: (1) by means of filters and a c.r.o. display; (2) by playing back the signals recorded on the tape, again using the filters and the c.r.o.; and (3) by introducing in addition a panoramic ultrasonic analyser or a special sound-measuring and analysing system. The tests showed that porpoises emit (*a*) bird-like whistles of 0·5 sec duration extending from 7 to 15 kc/s and (*b*) clicks of $\sim$ 1 msec duration and upwards with a repetition rate of 5–100/sec and a spectrum extending well above 120 kc/s. Both types of signal would be suitable for echo-sounding and ranging. H. G. M. SPRATT

OPTICS . RADIATION . SPECTRA 535

535.1

4676. Further experiments on the nature of light. J. STARK. *Z. Phys.*, **133**, *No.* 4, 504–12 (1952) *In German.*

Examination of a beam of polarized light which had passed through an inhomogeneous electric field *in vacuo* indicated a deflection, varying when the plane of polarization was changed. The experiments are fully described and a theoretical explanation is proposed. P. M. DAVIDSON

535.1 : 535.42

4677. A fundamental theorem of parageometrical optics. G. TORALDO DI FRANCIA. *J. Opt. Soc. Amer.*, **43**, 368–9 (*May*, 1953).

See Abstr. 918 (1951). The fundamental law of parageometrical optics, which has been proved for diffraction at a plane surface, is now extended to the case of a curved surface of any type. A.

535.1 : 535.43

4678. Remarks on the theory of an effect reported by M. Robert Lennuier. G. BECK. *C.R. Acad. Sci.* [*Paris*] **235**, 465–7 (*Feb.* 2, 1953) *In French.*

See Abstr. 2522 (1947). The observed excitation of resonances in Hg vapour by light of a neighbouring frequency is discussed. An attempt to interpret this as the collision of wave packets representing the emitting and absorbing atoms suggests that the (Born) approximation of current electrodynamics is insufficient. The effect may be a novel feature associated with conditions under which a distinction between transmission of energy by radiation and collision is not possible. W. J. SWIATECKI

535.12

4679. Propagation of the wave from an instantaneous point source in two semi-infinite media. H. G. GARNIR. *Bull. Soc. Roy. Sci. Liège*, **22**, 85–100 (*Feb.*, 1953) *In French.*

The Green's function is developed in a form which exhibits clearly the evolution of the primary, reflected and refracted waves. P. M. DAVIDSON

535.231.2 : 535.33

4680. Nomogram for the evaluation of blackbody radiancy and of peak and total intensities for spectral lines with Doppler contour. R. W. KAVANAGH, E. K. BJÖRNERUD AND S. S. PENNER. *J. Opt. Soc. Amer.*, **43**, 380–2 (*May*, 1953).

The basic equations used for the construction of the nomogram and the use of the nomogram are described briefly. A method is outlined for determining absolute values of total intensities for spectral lines with combined Doppler and resonance contour by using the nomogram in conjunction with the "curves of growth." A.

535.231.2 : 535.33

4681. Nomogram for the evaluation of blackbody radiancy and of peak and total intensities for spectral lines with Lorentz contour. R. W. KAVANAGH AND S. S. PENNER. *J. Opt. Soc. Amer.*, **43**, 383–4 (*May*, 1953).

535.24

4682. Photometry. J. W. T. WALSH. *2nd Ed.* [*Revised*]. *London*: *Constable* (1953) xxiv + 544 *pp.*, 281 *figs.*

More than two-thirds of the 1925 edition has been rewritten to make a textbook and reference book as up to date, comprehensive and authoritative as its well-known predecessor. References to all papers published since 1925 are given, with a selection of earlier ones.

535.31 : 771.3

4683. The resolving power for the combination of photographic plate and objective. E. MENZEL AND W. KLEINN. *Optik*, **4**, *No.* 11, 481–5 (1952) *In German.*

To provide various degrees of resolution from a single objective, the test object was a circular pattern of black and white sectors illuminated by transmission of a parallel beam of monochromatic light. An image was formed by a microscope objective followed by a narrow slit in the focal plane of the objective. The visually observed, or photographed, image thus varied in sharpness with azimuth. The "unsharpness" or reciprocal of the resolving power was found to be the sum of the separate contributions of plate and objective. S. T. HENDERSON

535.314 : 535.326

4684. Luminous trajectories in a transparent space. Existence of unilluminated regions. F. BERTOLINI. *R.C. Accad. Naz. Lincei*, **14**, 26–8 (*Jan.*, 1953) *In Italian.*

An application of the calculus of variations to the study of light rays in a medium with variable refractive index. L. S. GODDARD

535.314 : 535.326

4685. Ray deflection through a medium having a continuously varying refractive index. S. WOLIN. *J. Opt. Soc. Amer.*, **43**, 373–5 (*May*, 1953).

General equations are developed by applying the calculus of variations to Fermat's principle of optics. These equations are applied to the case of a dielectric material having a linear variation with distance in its refractive index and also to the case of a foam dielectric having a linear variation in density. A set of universal curves is presented for the case of a plane dielectric sheet having a linearly varying dielectric

constant. The general equations presented here can also be applied to the design of lenses and optical devices having a continuously varying refractive index. A.

535.317

4686. Certain unsymmetrical pancratic systems of three lenses. A. Biot. *Ann. Soc. Sci. Bruxelles*, **66**, *No.* 3, 152–5 (1952) *In French.*

The system investigated has two unequal positive lenses on either side of a negative lens. The two positive lenses move together, relative to the fixed negative lens and object, and the position of the image is determined by thin lens equations. The condition for the image to remain stationary can then be found. R. W. FISH

535.317.1

4687. Analysis and synthesis of optical images. J. E. Rhodes, Jr. *Amer. J. Phys.*, **21**, 337–43 (*May*, 1953).

The formation of an optical image by a lens is often treated so that the image appears as the double Fourier transform of the object, limited by the aperture of the lens and other stops. This treatment is here presented including details that are usually omitted in articles where an application of the treatment is the primary purpose. Separate developments are presented that are most adaptable, respectively, to the configuration usually used with a microscope objective with a short object distance and a large image distance, and to the configuration normally used with a telescope objective. A.

535.317.1 : 535.42

4688. On the diffraction theory of optical images. H. H. Hopkins. *Proc. Roy. Soc. A*, **217**, 408–32 (*May* 7, 1953).

The theory of image formation is formulated in terms of the coherence function in the object plane, the diffraction distribution function of the image-forming system and a function describing the structure of the object. There results a four-fold integral involving these functions, and the complex conjugate functions of the latter two. This integral is evaluated in terms of the Fourier transforms of the coherence function, the diffraction distribution function and its complex conjugate. In fact, these transforms are respectively the distribution of intensity in an "effective source," and the complex transmission of the optical system—they are the data initially known and are generally of simple form. A generalized "transmission factor" is found which reduces to the known results in the simple cases of perfect coherence and complete incoherence. The procedure may be varied in a manner more suited to non-periodic objects. The theory is applied to study *inter alia* the influence of the method of illumination on the images of simple periodic structures and of an isolated line. A.

535.317.4

4689. Third-order methods as applied to zonal aberrations of single long focal length lenses. A. I. Mahan and H. A. Templin. *J. Opt. Soc. Amer.*, **43**, 356–65 (*May*, 1953).

The apertures of single long focal length lenses were restricted in various ways to obtain large zonal patterns which could be readily observed and photographed. These zonal patterns were photographed in planes normal to the lens axis at different distances from the lens so that their changes in form with distance from the lens could be seen. Photographs were made for lenses of different designs to show how the design influenced these patterns. The zones of light transmitted by these lenses were either circular or rectangular in shape. Some very interesting geometrical figures can be obtained in this way. The third-order methods of L. Seidel were then used to calculate the forms of these zonal patterns in the paraxial image plane and a comparison made between the calculated and photographed patterns. To calculate the forms of these patterns in planes other than the paraxial image plane, a modification of Finsterwalder's ray equations was used. The zonal patterns in the paraxial image plane were then projected into other planes normal to the lens axis and displaced from the paraxial image plane. Again a comparison was made between the calculated and photographed patterns. These zonal patterns were also observed with a white light source. A.

535.32

4690. The dispersion of standard air. B. Edlén. *J. Opt. Soc. Amer.*, **43**, 339–44 (*May*, 1953).

By combining Barrell and Sears' measurements in the visible and Koch's and Traub's in the ultraviolet, a dispersion formula for standard air has been derived, viz., $(n-1)10^8 = 6432\cdot8 + 2\,949\,810(146-\sigma^2)^{-1} + 25\,540(41-\sigma^2)^{-1}$, σ being vacuum wave number in μ^{-1}, which should satisfy all needs of precision spectroscopy, in particular for converting wavelengths in air into vacuum values. A.

535.323 : 535.41 : 531.715

4691. On the determination of the refractive index and the thickness of plane parallel plates with the help of optical interference. K. J. Hakoila. *Ann. Univ. Turku A*, **12**, *No.* 1, 99 *pp.* (1952) *In German.*

A study of the interference in thick parallel plates illuminated at various angles of incidence. It is shown that by combination with oblique and normal incidence observation both the refractive index and the thickness can be calculated. It is shown how the technique can be applied to the study of the refractive index of a liquid. The errors are analysed in detail. Construction of the apparatus is described. Precision attained is very high. Refractive indices are given to the seventh decimal place. S. TOLANSKY

535.33.03

4692. On the carbon flame method and its application to the excitation of pure band spectra. A. Gatterer. *J. Opt. Soc. Amer.*, **43**, 345–6 (*May*, 1953).

The method is not universal, for it does not work at highest temperatures, and it fails in some cases of chemical interference between carbon and sample. Nevertheless, its applicability and usefulness are considerable. Six advantages may be mentioned. (1) The apparatus is simple and always ready for service. (2) The extraordinary intensity of the flame secures short exposures (10–30 sec) for spectra which fade away quickly. (3) The method gives band spectra which are nearly free of atomic lines. (4) It permits

distinction between arc and spark lines, and the bands can be tested for sensitivity to temperature. (5) Since the excitation potential of the carbon flame lies between those of the electric arc and the ordinary gas flame, new bands important for molecular chemistry and for the interpretation of stellar spectra, sometimes appear. (6) The method, though chiefly suited for oxide spectra, is not at all limited to this type of spectra. Spectra of fluorides, bromides, chlorides and iodides turn out very well, as may be seen in the SrCl spectrum. A.

535.33.03 : 537.523.5

4693. The carbon arc as a radiation standard for spectrophotometry in the wavelength range 0·25 to 1·8 μ. J. EULER. *Ann. Phys.* [*Leipzig*] **11**, *No.* 4–7, 203–24 (1953) *In German.*

Describes a detailed study of the spectral characteristics of the cathode crater region of a carbon arc in air, from which it is found that the temperature of the crater (given as 4995 ± 20°K) is largely independent of arc conditions for reasonable ranges of the various parameters. Thus the arc provides a standard spectrum, for the visible, near u.v. and near i.r. The paper describes, in detail, the various optical systems used in the work. J. D. CRAGGS

535.33.07–15

4694. A simple quartz infra-red spectrometer for the determination of absorbed water in some polymers. E. R. S. JONES. *J. sci. Instrum.*, **30**, 132–4 (*April*, 1953).

The instrument described was specially built for the rapid determination of absorbed water in some acrylic resins by an infra-red absorption method. It comprises a quartz half-prism and fused silica lenses, employs a Nernst glower as light source, and a vacuum thermopile and galvanometer amplifier system for detection. The measurements are made on an absorption band located in the near infra-red (2 μ) which is shown to give a linear relationship between extinction coefficient and percentage by weight of absorbed water over the range normally encountered; only at high water absorptions does departure from linearity become apparent. A.

535.33.07–31 : 535.421

4695. Improvement of grating efficiency in the vacuum ultraviolet by platinizing. K. WATANABE. Letter in *J. Opt. Soc. Amer.*, **43**, 318 (*April*, 1953).

The efficiency of a grating in the wavelength range 1100–1650 Å is found to be considerably increased when a coating of Pt, 1600 Å thick, is sputtered on to it. D. G. AVERY

535.33.337

4696. The spectral intensity distribution in a neon line for various discharge conditions. K. LANG. *S.B. Österr. Akad. Wiss. IIa*, **161**, *No.* 1–3, 65–87 (1952) *In German.*

A detailed description of line width measurements, taken with a Fabry–Pérot interferometer (3–10 mm plate separation), for the neon line 5852·49 Å. A variety of discharge tube conditions (e.g. 50 c/s and 23 Mc/s excitation) showed that the line widths were not thereby altered. Variations of pressure from 1 to 100 mm Hg showed increasing line widths for increasing pressures. Half-intensity widths are $\sim 10 - 40 \times 10^{-3}$ Å. The results are briefly discussed, with reference to Doppler and pressure broadening. J. D. CRAGGS

535.338

4697. Intensity distribution of a continuous absorption spectra in relation to temperature and wave number. P. SULZER AND K. WIELAND. *Helv. phys. Acta*, **25** *No.* 6, 653–76 (1952) *In German.*

The variation of intensity of the visible absorption spectrum ($\lambda\lambda$ 6000 3200 Å) of I_2 vapour has been quantitatively measured as a function of the temperature (423°–1323°K). The variation of intensity of a continuous absorption spectrum with temperature T and frequency ν has been calculated by wave mechanics in a general way for diatomic molecules. Under suitable simplifications (absorption curve = Gaussian curve of constant area) the following formula has been deduced for the extinction coefficient ε of a diatomic molecule:

$$\varepsilon_T(\nu) = \varepsilon_0^m \left[\mathrm{Tg}\left(\frac{\Theta_0}{2T}\right)\right]^{\frac{1}{2}} \cdot \exp. - \left[\mathrm{Tg}\left(\frac{\Theta_0}{2T}\right)\right]\left(\frac{\nu - \nu_0}{\Delta\nu_0^*}\right)^2.$$

This means: ε is calculable as a function of T and ν if—apart from the a priori known vibration frequency $\omega_0 = \Theta_0/1{\cdot}439$—the following 3 constants are given: ε_0^m the maximum extinction coefficient at 0°K, ν_0 the frequency of the absorption maximum and $\Delta\nu_0^*$ the half-width of the absorption curve at 0°K. The constants can be obtained from a single absorption curve measured at an arbitrary temperature. A still simpler formula holds for the temperature dependence of the absorption maxima $\varepsilon_T^m(\nu = \nu_0)$:

$$\varepsilon_T^m = \varepsilon_0^m \left[\mathrm{Tg}\left(\frac{\Theta_0}{2T}\right)\right]^{\frac{1}{2}}.$$

The calculated ε-values are compared and found to be in fairly good agreement with the measured values of the molecules Cl_2, Br_2 and I_2. There is also a good coincidence between the measured and the calculated absorption curves of diphenyl vapour if $(C_6H_5)_2$ is treated as a diatomic molecule with $\omega_0 = 265\ \mathrm{cm}^{-1}$ (vibration frequency of the two phenyl groups). A.

535.338

4698. The emission spectrum of aluminium monofluoride. S. M. NAUDÉ AND T. J. HUGO. Letter in *Phys. Rev.*, **90**, 318 (*April* 15, 1953).

A number of new systems of AlF are briefly reported. The vibrational analysis of the $A^1\Pi - X^1\Sigma^+$ system [Rochester, *Phys. Rev.*, **56**, 305 (1939)] has been amended, and vibrational and rotational analyses of a new system, $^1\Sigma - A\ .\ ^1\Pi$, with $\nu_e = 13\,739{\cdot}5\ \mathrm{cm}^{-1}$, have been carried out. R. F. BARROW

535.338

4699. The band-spectrum of aluminium monofluoride. H. C. ROWLINSON AND R. F. BARROW. *Proc. Phys. Soc.* [*London*] *A*, **66**, 437–46 (*May*, 1953).

The spectrum of AlF has been studied in emission, and four systems have been found. An amended vibrational analysis of the system $A\ .\ ^1\Pi - X^1\Sigma^+$, in general agreement with Naudé and Hugo (preceding abstract) is put forward. The vibrational analysis of a complex system of violet degraded bands at 3450–3720 Å, which appears to arise from a $^3\Sigma$–$^3\Pi$ transition, has also been carried out. Band-head measurements of a complex system at 5450–6020 Å,

and of the $^1\Sigma - A^1\Pi$ system are given. Emission bands previously ascribed to AlF by Yuasa (1938) have not been observed: it appears that these bands may be due to S_2. The dissociation energy of AlF is briefly considered. A comparison of the thermochemical and spectroscopic values suggests that there may be a potential maximum in the $A^1\Pi$ state.

R. F. BARROW

535.338.3

4700. Self-reversal of the H_α hydrogen line in the high pressure spark discharge. H. FISCHER. *J. Opt. Soc. Amer.*, **43**, 394–7 (*May*, 1953).

With increasing gas pressure and spark energy, the Balmer lines in the hydrogen spectrum (with the exception of H_α) become so wide and overlapping that they form a continuous spectrum, as is well known. Only H_α remains relatively sharp and separated even with the highest energies obtained so far. By increasing the energy density in the spark channel substantially beyond the present limits, H_α also widens considerably and finally shows reversal in its centre. The spectral range of the reversal widens with increasing energy and gas pressure. The phenomenon is discussed.

A.

535.338.332

4701. The spectrum of gadolinium II. N. ZELDES. *Phys. Rev.*, **90**, 413–15 (*May* 1, 1953).

A comparison was made between theory and experimental data for the spectrum of Gd II. All bary-centres of the terms fit very well to the theoretical formulae, but the calculation of the Landé g factors shows deviations from LS behaviour.

A.

535.338.333

4702. Contributions to the isotope shift effect in the atomic spectra of the heavy elements. W. HUMBACH. *Z. Phys.*, **133**, *No.* 5, 589–614 (1952) *In German.*

Values of the isotope shift constant (Is.V.K.) are tabulated for the nuclear model of a homogeneously charged sphere, and methods of calculation for other models are indicated. The effect of screening of inner electron shells is discussed at length. Neither the assumption of strong deviation from homogeneous charge distributions, nor the consideration of screening effects will remove the discrepancy between theoretical and experimental Is.V.K., as long as nuclear radii are considered to increase with (mass number)$^{\frac{1}{3}}$.

J. JACOBS

535.338.4

4703. The spectrum of NH_3 at low pressures. P. PROISY. *Ann. Phys.* [*Paris*], **8**, *No.* 1–2, 5–13 (1953) *In French.*

Gives detailed results of an investigation into the emission spectrum of NH_3 at about 0·1 mm Hg pressure, excited in a Schüler tube. Wavelengths, measured to about 0·1 Å, are plotted in extensive tables, and compared with earlier data (1923) due to Rimmer. Approx. relative intensities are also given.

J. D. CRAGGS

535.338.4

4704. The 2700 Å-system in the band-spectra of AlH and AlD. B. KLEMAN. *Ark. Fys.*, **6**, *Paper* 40, 407–14 (1953).

A rotational analysis of the 1,1 and 1,0 bands of a transition $C\,^3\Pi_r - a\,^3\Pi_r$ in AlD has been carried out. The lower state is known in AlH from the transition $^3\Sigma - a\,^3\Pi_r$. The constants for the state $c\,^3\Pi_r$ are (cm^{-1}): $B_1 = 2{\cdot}938$, $D_1 = 3\times10^{-5}$, $0 < A < 12$, $\nu_{1,0} = 37\,708{\cdot}0$, $\omega_e \sim 800$. This state is perturbed, probably by a Σ state, and is predissociated in $v = 1$ at $K \sim 16$.

R. F. BARROW

535.338.4–32

4705. NO, NO^+ and N_2^+ emission spectra in the Schumann region. P. BAER AND E. MIESCHER. *Helv. phys. Acta*, **26**, *No.* 2, 91–110 (1953) *In German.*

The following results are obtained from emission spectra of a discharge in NO gas, partially with enriched N^{15} isotope: (1) A new band system (β') of the NO molecule in the region 2000 — 1550 Å forms a $B'\,(^2\Sigma) - X^2\Pi$-transition. (2) Bands in the visible region are interpreted as $B'\,(^2\Sigma) - B^2\Pi$ system of NO. (3) Isotope shifts observed in the γ and ε bands of the NO molecule definitively show that these bands form two separate systems. (4) A new band system $A^1\Pi - X^1\Sigma^+$ of the ion NO^+ is found between 1700 and 1350 Å. (5) Isotope shifts observed in N_2^+ bands settle the vibrational analysis of the $C^2\Sigma - X^2\Sigma$-system of the N_2^+ ion.

A.

535.343

4706. Radiation from isolated spectral lines with combined Doppler and Lorentz broadening. S. S. PENNER AND R. W. KAVANAGH. *J. Opt. Soc. Amer.*, **43**, 385–8 (*May*, 1953).

Methods for the calculation of spectral absorption coefficients for combined Doppler and Lorentz broadening are summarized. The "curves of growth" have been extended to cover the ranges of parameters which arise in spectroscopic studies on flames. [See also Abstr. 4680–1 (1953)].

A.

535.343–14 : 539.15

4707. Relations between high frequency techniques and atomic and nuclear physics. W. GRAFFUNDER. *Rev. Cienc. apl.*, **7**, 1–8 (*Jan.–Feb.*, 1953) *In Spanish.*

535.343–15

4708. Infrared spectrum of deuterosubstituted vinyl bromides. J. CHARETTE AND M. DE HEMPTINNE. *Bull. Acad. Roy. Belgique Cl. Sci.*, **38**, *No.* 10, 934–56 (1952) *In French.*

Extensive spectral data are found and tabulated for all the deutero-substituted vinyl bromides. Assignments are given and checked with previous results where possible. On the whole there is good agreement with results found by Hemptinne and Velghe (1945). The frequencies for the non-planar vibrations can also be assigned.

A. J. TAYLOR

535.343–32

4709. Ultra-violet absorption spectra of halogenated toluenes. G. VISWANATH. Letter in *Curr. Sci.*, **22**, 41–2 (*Feb.*, 1953).

The spectra of *o*- and *m*-chlorotoluene and *o*-bromotoluene are briefly discussed.

G. I. W. LLEWELYN

535.343.2–15

4710. Frequency changes with orientation in the infrared spectrum of crystals. L. COUTURE-MATHIEU, J. A. A. KETELAAR, W. VEDDER AND J. FAHRENFORT. *Physica*, **18**, 762–70 (*Oct.*, 1952) *In French.*

For the reflection spectra of monocrystals, if ϕ is the angle between the moment $\vec{M}$ created in the

vibration, and the wave vector $\vec{k}$, then the following changes in wavenumber as a function of ϕ are observed: quartz, A_2 vibration: 776·5 cm^{-1} ($\phi = 90°$) to 784·5 cm^{-1} ($\phi = 11°$); E vibration: 796·5 cm^{-1} ($\phi = 90°$) to 803 cm^{-1} ($\phi = 20°$); lithium perchloride: 1138 cm^{-1} ($\phi = 80°$) to 1149 cm^{-1} ($\phi = 20°$); iodic acid 718 cm^{-1} ($\phi = 90°$) to 722 cm^{-1} ($\phi = 22·5°$), 751 cm^{-1} ($\phi = 90°$) to 769 cm^{-1} ($\phi = 45°$), 772 cm^{-1} ($\phi = 90°$) to 779 cm^{-1} ($\phi = 45°$), 804 cm^{-1} ($\phi = 90°$) to 809 cm^{-1} ($\phi = 45°$), 814 cm^{-1} ($\phi = 90°$) to 825 cm^{-1} ($\phi = 45°$). The frequency increases with decreasing ϕ. C. TURNER

535.343.2–31 : 535.51

4711. Polarized ultra-violet absorption of anthracene. D. P. CRAIG AND P. C. HOBBINS. Letter in *Nature* [*London*] **171,** 566 (*March* 28, 1953)

In order to make comparisons with theoretically calculated results, the polarization of u.v. bands was investigated. Thin crystals were prepared, the face of which was shown to be the 001 plane, and the position of the *a* and *b* crystal axes in this plane was found by X-ray and microscopy. The optical densities for the two directions of polarization of (polarized) light which had passed through the crystals were measured. The band system at 2700 Å was found to be polarized along the shorter in-plane axis, that at 3800 Å showed a strong component along this axis, and that at 2300 Å was polarized along the longer in-plane axis. A. J. TAYLOR

535.343.3–14

4712. Resonance absorption in liquid methyl palmitate and methyl stearate in the microwave region. T. J. BUCHANAN. Letter in *Nature* [*London*] **171,** 695–6 (*April* 13, 1953).

Methyl palmitate and stearate below 40°C, but not the ethyl esters, show indications of a resonance absorption at 6000 Mc/s superimposed on the relaxation absorption and dispersion. D. H. WHIFFEN

535.343.4–14

4713. One to two millimeter wave spectroscopy. I. W. C. KING AND W. GORDY. Letter in *Phys. Rev.*, **90,** 319 (*April* 15, 1953).

Absorption lines are obtained for OCS up to 219 000 Mc/s (1·37 mm), $J_{17\to18}$, by using improved detecting crystals and a redesigned crystal multiplier. $B_0 = 6081·490$ Mc/s and $D_J = 1·294 \pm 0·005$ Mc/s. D. H. WHIFFEN

535.343.4–14 : 539.132

4714. The microwave absorption spectrum of O_2^{16} and $O^{16}O^{17}$. S. L. MILLER AND C. H. TOWNES. *Phys. Rev.*, **90,** 537–41 (*May* 15, 1953).

The theory of the fine structure of O_2 is made somewhat more complete and fitted to the observed microwave spectrum. This gives $B_0 = 43\,102 \pm 5$ Mc/s for $O^{16}O^{16}$. In addition there is evidence for the effect of higher-order terms such as centrifugal distortion on the magnetic interaction constants. Magnetic hyperfine structure has been observed in the spectrum of $O^{16}O^{17}$. The spectrum agrees with that predicted on the basis of a perturbation Hamiltonian $b\mathbf{I}\cdot\mathbf{S} + cI_zS_z$, where $b = -102$ Mc/s and $c = 140$ Mc/s. The value of 5/2 for the spin of O^{17} is confirmed. A.

535.343.4–14 : 539.133

4715. Microwave spectrum and structure of SiD_3F. B. BAK, J. BRUHN AND J. RASTRUP-ANDERSEN. Letter in *J. chem. Phys.*, **21,** 752–3 (*April*, 1953).

535.343.4–14 : 539.133

4716. Microwave spectrum and structure of SiD_3Cl. B. BAK, J. BRUHN AND J. RASTRUP-ANDERSEN. Letter in *J. chem. Phys.*, **21,** 753–4 (*April*, 1953).

535.343.4–32

4717. Absorption of water vapour in the Schumann ultraviolet. A. JOHANNIN-GILLES. *C.R. Acad. Sci.* [*Paris*] **236,** 676–8 (*Feb.* 16, 1953) *In French.*

Measurements of density of absorption D at various pressures p and cell lengths l in the region 1600 Å–1850 Å indicate that the Beer–Lambert law is not obeyed, but that $D = (pl)^{2/3}$. It is suggested that the bands are incompletely resolved predissociation bands. G. F. LOTHIAN

535.345 : 535.41

4718. Phase and intensity measurements for some aluminum films. K. ISHIGURO AND G. KUWABARA. *J. Opt. Soc. Amer.*, **43,** 365–7 (*May*, 1953).

A Rayleigh–Lowe interferometer has been modified in such a way that phase changes resulting from transmission through very thin metallic films can be magnified by a factor of four. These phase changes were measured for a series of aluminum films of different thicknesses both for normal incidence and for an angle of incidence of 70° using light of wavelength 590 millimicrons. For the measurements at oblique incidence, the light was plane polarized with the magnetic vector parallel and perpendicular to the plane of incidence. Reflection and transmission measurements were also made on each of these films for the same wavelength. A.

535.345–15

4719. A modulated-beam method of measuring infra-red absorption at high temperatures. L. GENZEL AND N. NEUROTH. *Z. Phys.*, **134,** *No.* 2, 127–35 (1953) *In German.*

Full experimental details of an apparatus which can be used up to 1500°C. At a wavelength of 2·5 μ the absorption coefficient of a commercial glass begins to increase at the transformation temperature and rises from 0·18 cm^{-1} at 600°C to 0·34 cm^{-1} at 1200°C. R. O. DAVIES

535.345.6–15

4720. A variable infrared filter. G. JOOS. *Optik*, **9,** *No.* 12, 546 (1952) *In German.*

The transmissions of a single polaroid screen and of crossed and parallel pairs of screens have been measured in the region 0·7–2·0 μ. The results show that crossed, rotatable, polaroid screens may be used as a filter in the region $\lambda < 0·9$ μ. H. H. HOPKINS

535.361.2 : 539.234

The effect of vapor incidence on the structure of evaporated aluminium films. *See Abstr.* 5126

535.37 : 541.183

4721. Luminescence and adsorption phenomena in some oxides and halides. J. EWLES AND C. N. HEAP. *Trans Faraday Soc.*, **48,** 331–8 (*April*, 1952).

In a previous communication luminescent effects

associated with the wetting of non-luminescent solids with non-luminescent liquids were described [Abstr. 3130 (1949)]. In the present paper an account is given of further experiments in this field. Improved arrangements have been set up for heating the solid, redistilling the wetting liquid and bringing the two into contact *in vacuo* and sealing-off for spectroscopic and other examination without exposure at any time to air. It has been found that solids in which the luminescence associated with adsorption had been removed by long heating in dry air or pure dry oxygen lose to a considerable extent their power of adsorption. Reheating *in vacuo* or in reducing gases introduces new luminescent effects and restores in appreciable measure the power of adsorption and the luminescence associated with it. Emission spectra have been obtained at the temperature of the room and of liquid air. Excitation spectra have been obtained photo-electrically with a source of continuous u.v. light whose intensity distribution has been measured by a new method. It is suggested that the luminescent effects described arise in molecules adsorbed at active sites provided by anion defects in the crystal lattice of the adsorbent, and an attempt is made to relate observations to the nature of adsorption processes. A.

535.371

4722. On the variation, with wavelength of excitation, of the degree of polarization of fluorescence of dyestuffs. E. Laffitte. *C.R. Acad. Sci.* [*Paris*] **236,** 680–2 (*Feb.* 16, 1953) *In French.*

535.371

4723. Measurement of the decay time of luminescence with the phase tube. F. Rohde. *Z. Naturforsch.*, **8a,** 156–61 (*Feb.–March*, 1953) *In German.*

A new method of measuring decay time of luminescence is described. Luminescence is excited by an electron beam modulated at high frequency and is detected by a photomultiplier. The phase difference between modulation of exciting beam and the luminescence is compared using a standard fluorescent material. Measurements are made on dyestuffs in polystyrene. G. F. J. GARLICK

535.372

4724. Measurement of fluorescent spectra of liquids with a modified Beckman DU spectrophotometer. F. B. Huke, R. H. Heidel and V. A. Fassel. *J. Opt. Soc. Amer.*, **43,** 400–4 (*May*, 1953).

A description is given of an attachment for the Beckman DU spectrophotometer for measuring the fluorescent spectra emitted by liquids and solutions. The external optical system normally used for absorption spectra measurements was modified to provide optimum fluorescent intensity with minimum interference from scattered and reflected primary radiation and from fluorescence of the cuvettes. Modifications were also made in the input circuit to permit use of a photomultiplier detector for increased sensitivity. Otherwise, the amplifying and dispersing systems of the instrument were used in the usual manner. Typical spectral distribution and analytical curves and sensitivity data obtained with this attachment are included. A.

535.375.1

4725. Intensification in zinc selenide phosphors. S. Larach. Letter in *J. chem. Phys.*, **21,** 756 (*April*, 1953).

Addition of chloride to the phosphors intensifies the host lattice and added activator emissions, but addition of Al^{+++} does not affect the lattice emission. It has a poisoning effect on the added activator emission. Ga^{+++} acts as poison to the host lattice emission but intensifies the added activator emission. G. F. J. GARLICK

535.375.1

4726. The mechanism of phosphorescence in crystal phosphors. D. Curie. Letter in *Phys. Rev.*, **90,** 154 (*April* 1, 1953).

A summary of results given in detail in the author's thesis [Abstr. 2364 (1953)] on such problems as monomolecular and bimolecular phosphorescence processes, thermoluminescence and infrared stimulation of sulphide phosphors. G. F. J. GARLICK

535.375.5

4727. The Raman spectra of the compounds $NaCl.AlCl_3$ and $NOCl.AlCl_3$. H. Gerding and H. Houtgraaf. *Recueil Trav. chim. Pays-Bas*, **72,** 21–38 (*Jan.*, 1953).

535.375.5

4728. The Raman spectrum of liquid and solid gallium trichloride. H. Gerding, H. G. Haring and P. A. Renes. *Recueil Trav. chim. Pays-Bas*, **72,** 78–83 (*Jan.* 1953).

535.375.5

4729. Internal oscillations of the SO_4 ion in a monocrystal of $ZnSO_4.7H_2O$. R. Lafont. *C.R. Acad. Sci.* [*Paris*] **236,** 678–80 (*Feb.* 16, 1953) *In French.*

The similarity between the scattering spectra of $MgSO_4.7H_2O$ and $ZnSO_4.7H_2O$ indicates that these sulphates have identical structures. G. I. W. LLEWELYN

535.375.5

4730. A Raman apparatus for gases. H. H. Claassen and J. R. Nielsen. *J. Opt. Soc. Amer.*, **43,** 352–5 (*May*, 1953).

The apparatus is of simple construction, using aluminum foil wrapped around a single mercury arc and Raman tube to concentrate the light. The fundamentals of both O_2 and N_2 in a sample of air at eight atmospheres were photographed in an exposure of $1\frac{1}{2}$ hours. Spectra of gaseous fluoroform and ammonia are presented. A.

535.375.5 : 539.132

4731. Intensities in Raman spectra. I. A bond polarizability theory. D. A. Long. *Proc. Roy. Soc. A*, **217,** 203–21 (*April* 8, 1953).

Theories of Raman intensities are reviewed, and it is shown that no satisfactory theory exists which enables relative intensities to be predicted. A matrix method for calculating the derived invariants of the molecular polarizability in terms of polarizability functions characteristic of bonds and general coefficients defining the normal mode of vibration is presented. The method is an extension of the well-known matrix techniques for the vibrational problem.

The general theory is simplified by making approximations first suggested by Wolkenstein (1941). In this approximation each distinct bond is characterized by three polarizability functions; these may be deduced from measured intensities in much the same way as force constants may be deduced from frequencies. General formulae for setting up the matrices are given, and completely general formulae for intensities in terms of bond polarizabilities, to the Wolkenstein approximation, are quoted in full for molecules of the types $MX_2(C_{2v})$, $MX_4(T_d)$, $MX_3Y(C_{3v})$ and $MX_2Y_2(C_{2v})$. A.

535.375.5 : 541.65

4732. Raman intensity and chemical structure. M. HARRAND. *Ann. Phys.* [*Paris*] **8,** 126–68 (*Jan.–Feb.*, 1953) *In French.*

The frequencies and intensities of the Raman lines of 15 crystalline dihalogeno-nitrobenzenes and of several crystalline derivatives of chalcone and of cinnamic acids have been determined, the observed spectra being very intense if the powder is yellow-coloured. Possible modes of oscillation of the NO_2 group in the nitrobenzenes are discussed. A description of the apparatus used for determination of the intensity of the Raman spectra of organic liquids is given and the results obtained for a large number of such liquids, chiefly benzene derivatives, are tabulated. The exaltation of the intensity is related to the presence of an unsaturated conjugated system in the molecule; it increases as the number of conjugated atoms increases, and decreases on introduction of a saturated radical. The effect of this exaltation is noted with (*a*) the absolute intensity of the Raman lines, (*b*) the intensity of the Rayleigh line, (*c*) the relative intensity of certain Raman lines. The spectral results are correlated with other physical properties, e.g. depolarization factor, and the exaltation of molecular refraction. An attempt is made to calculate the molecular polarizabilities of both conjugated and non-conjugated molecules with a view towards explaining the observed spectral results.

G. I. W. LLEWELYN

535.375.5 : 548.7

4733. Scattering spectra of piezoelectric crystals. IV. Blende. L. COUTURE-MATHIEU AND J.-P. MATHIEU. *C.R. Acad. Sci.* [*Paris*] **236,** 371–3 (*Jan.* 26, 1953) *In French.*

For Pt III, see Abstr. 8086 (1952). With incident radiation $\lambda = 4358$ Å, the fundamental vibration of ZnS is decomposed into longitudinal vibration of frequency 349 cm^{-1} and a transverse vibration of frequency 274 cm^{-1}. G. I. W. LLEWELYN

535.375.5 : 548.7

4734. Application of the macroscopic theory of ionic networks to the scattering spectrum of blende. H. POULET. *C.R. Acad. Sci.* [*Paris*] **236,** 373–4 (*Jan.* 26, 1953) *In French.*

The relationship between the frequencies of transverse and longitudinal vibrations respectively in ZnS, calculated by the macroscopic theory of ionic crystals, is in agreement with experimental results.

G. I. W. LLEWELYN

535.376

4735. Study of fluorescence excited in zinc sulphide by α-particles using a photoelectron multiplier. P. LEUBA AND J.-P. ANTHONY. *C.R. Acad. Sci.* [*Paris*] **236,** 374–7 (*Jan.* 26, 1953) *In French.*

A study is made of the form of the output pulses from a scintillation counter in relation to the phosphor decay time and the time constant of the output circuit of the photomultiplier. An initial decay time of 2×10^{-6} sec is reported for a zinc sulphide phosphor specimen. G. F. J. GARLICK

535.376

4736. Atomic mercury as a luminescent activator. J. S. PRENER, R. E. HANSON AND F. E. WILLIAMS. Letter in *J. chem. Phys.*, **21,** 759–60 (*April*, 1953).

Mercury is found to function as an emission centre in specimens of dehydrated zeolites under cathode-ray excitation, the emission having a maximum at 3700 Å.

G. F. J. GARLICK

535.39

4737. Measurement of the reflectivity of thick metallic films (Au, Pt, Cr) in the Schumann range and determination of the optical constants. S. ROBIN. *C.R. Acad. Sci.* [*Paris*] **236,** 674–6 (*Feb.* 16, 1953) *In French.*

Metallic films, opaque when transilluminated by a lamp, were prepared by evaporation *in vacuo*. Their reflectivity R was measured for angles of incidence of 18° and 45° for wavelengths between 1100 and 2000 Å. $R(45°) > R(18°)$ in all cases. $R^2(45°)_s \simeq R(45°)$ "thus confirming one of the conclusions of electromagnetic theory." n and k are calculated. Two graphs and one table are given. R. A. WEALE

535.39

4738. Multi-layer dielectric reflecting films at wavelengths between 4000 and 4600 Å. J. RING AND W. L. WILCOCK. Letter in *Nature* [*London*] **171,** 649 (*April* 11, 1953).

Measurements are reported for the reflection coefficient, transmission coefficient and absorption coefficient of a seven-layer multilayer consisting of a single sulphide and cryolite. These optical constants are given for wavelengths 4100, 4300 and 4500 at which the absorption coefficients reported are as low as 0·007, 0·005 and 0·003. The performance is compared with that of new and aged silver and theoretical resolution in an interference filter using the dielectric films is 15–20 times that obtained with silver. S. TOLANSKY

535.41

4739. Contribution to the theory of optical interference systems with given spectro-properties. H. POHLACK. *Ann. Phys.* [*Leipzig*] **11,** *No.* 4–7, 383–8 (1953) *In German.*

The transmission of an optical interference set-up which consists of separate films behind one another of equivalent optical thickness can be derived in the form of a linear polynome. By this means the hitherto unresolved problems connected with the synthesis of multiple layers for interference can be solved. Up to the present the interpolation methods have been used for calculation, but the present synthetic approach has advantages. Graphical methods of analysis are described and the intensity functions are obtained in a polynome form. S. TOLANSKY

535.412

4740. Fresnel's two mirror experiment. K. KEMPNI. *Period. math.-phys. astron.* [*Zagreb*] **7,** *No.* 2, 102–14 (1952) *In Serbo–Croat. Summary in German* (2 *pp.*).

An arrangement of the original Fresnel experiment allows the quantitative verification of the laws governing the interference. Practical details of the apparatus are given and some photographs of the fringes are reproduced. R. W. FISH

535.417

4741. Observations on the angle-mirror interferometer and aperture chamber [Lochkammer]. J. RIENITZ. *Optik*, **9,** *No.* 11, 512–22 (1952) *In German.*

A Michelson interferometer is modified by using right-angle mirrors, which permit side displacement of fringes of equal inclination. By placing a small aperture between source and dividing plate non-localized fringes can be formed [this the author calls the Lochkammer interferometer]. Some of the properties of the fringes formed by combining the systems are discussed. The system leads to Haidinger fringes which can take on elliptical, straight or hyperbola form. S. TOLANSKY

535.417 : 531.717

4742. An interferometer microscope for the accurate measurement of optical thickness. J. DYSON. Letter in *Nature* [*London*] **171,** 743–4 (*April* 25, 1953).

A polarization-interference microscope arrangement is described for the determination of the thickness of thin transparent films. The interferometric phase difference is determined with a modified half-wave plate. Settings to within a quarter degree can be made, corresponding to a path difference of 0·003 wavelengths in interference film. S. TOLANSKY

535.42 : 534

4743. The use of optical diffraction of divergent light by ultrasonic waves for demonstrating the angular dependence of diffraction of light by ultrasonic waves. E. HEINEMANN. *Optik*, **9,** *No.* 11, 486–97 (1952) *In German.*

The experiments of Bergmann and Goehlich [*Z. Phys.*, **38,** 9 (1937)] are repeated. A simple geometrical-optical theory is formulated and the results are checked experimentally by photographs taken at different distances behind the diffracting layer. In particular it is shown that the angular scattering by diffraction is determined by the angular variation of the zero order spectrum. The maxima and minima are determined by the Bragg reflections from the ultrasonic wave. H. H. HOPKINS

535.43

4744. Contribution to the study of the molecular scattering of light (Rayleigh effect) in dilute solutions of strong electrolytes. R. LOCHET. *Ann. Phys.* [*Paris*] **8,** 14–60 (*Jan.–Feb.*, 1953) *In French.*

Scattering is considered due to concentration fluctuations in a binary system (separation of charges being negligible). Debye's formulation [Abstr. 2425 (1944)] of the Einstein theory is modified by introduction of activity coefficients γ. Using known values of γ, a $f(\gamma)$ that is proportional to the Rayleigh scattering coefficient is plotted against concentration c for solutions of 24 electrolytes (halides and sulphates of alkalies, alkaline earths, etc.). Measurements scattering intensities in green light have been ma visually and photo-electrically and the results plott as $f(\gamma)$ against c. These experimental values $f(\gamma)$ are always less than the theoretical valu discrepancies being greater at higher concentratio and in the cases of small multiply-charged ions th have a large affinity for water molecules. It suggested that forces between the latter cause so regularity in the ion distribution with a consequ reduction in the scattered intensity. This view supported by measurements on solutions of sugar water-alcohol mixtures; for small sugar concentr tions, the smaller the proportion of water the mo nearly do the experimental and theoretical curv coincide. G. F. LOTHIA

535.434 : 531.715

4745. The use of unfiltered light in determinin particle radius by the polarization ratio of the scattere light. M. KERKER AND M. I. HAMPTON. *J. Opt. So Amer.*, **43,** 370–2 (*May*, 1953).

The light scattering technique of determining th radius of small spherical particles by measurement the polarization ratio is extended to the case of no monochromatic light. The new method is applied t sulphur and dibutyl phthallate aerosols irradiated b an unfiltered beam from a mercury vapour lamp. Th radii obtained with the unfiltered light are in agre ment with those obtained when monochromatic ligh is used.

535.51

4746. The production of linearly polarized light wit the aid of a thin absorbing layer. H. SCHOPPER *Optik*, **9,** *No.* 11, 498–511 (1952) *In German.*

A theoretical study is made of absorbing layer After deriving the amplitude and phase condition which exist in the layer, the optical constants an layer thicknesses for different angles of incidenc necessary to produce linearly polarized light are give in graphical form. For a fixed angle of incidence th amount of polarized light cannot be increased beyon that for the non-absorbing layer. It is shown tha the reflecting power of an absorbing layer is differen according to whether the light is incident from th air or the substrate. This fact can be used for bean splitting. Such layers are particularly useful for th i.r. and u.v. spectral regions. See G. Hettner, *Optik* **1,** 2 (1946). H. G. JERRARI

535.5

4747. Application of plastics to photoelastic inter ference experiments. R. LANDWEHR. *Optik*, **9,** *No.* 1 547–56 (1952) *In German.*

After a brief summary of the uses and propertie of optical plastics, details are given of a method usin Fizeau interference fringes for photoelastic studie Since the sum of the principal stresses in a straine model is proportional to the thickness change of th model this sum can be measured by an interferenc method. A plastic having high elasticity and sma stress-optical constant is required. The surfaces mus be worked to a high degree of flatness. Lucite an Plexiglass are suitable. Details are given wit photographs of experiments using Plexiglass.

H. G. JERRARI

535.551 : 541.182

4748. The use of streaming birefringence data to determine the size and size distribution of rod-shaped interacting particles. M. Joly. *Trans Faraday Soc.*, **48**, 279–86 (*March*, 1952).

For very dilute monodisperse suspensions of rod-shaped particles it is possible to calculate the particle length from the value of the extinction angle at a given velocity gradient; the length obtained by this means is independent of the rate of shear. But for a polydisperse system the same calculation gives an apparent particle length which varies with the velocity gradient. Inversely, for a given size distribution, we can calculate the extinction angle and the apparent particle length as a function of the velocity gradient. By plotting a series of curves of apparent length against rate of shear for a great number of size distributions we can find empirical relations giving the particle length of maximum frequency and the polydispersity from the values of the extinction angle for two given velocity gradients. When interaction occurs between the particles, the empirical relations must be applied to the values of the extinction angle extrapolated to zero concentration. Taking as a first approximation the plane motion of particles, we establish by mathematical treatment the equation giving the orientation distribution function when the interaction energy between the particles is not negligible. The expression of the corresponding apparent rotational diffusion constant is derived and the related increase of the apparent particle length is shown. From the variations of this length with the concentration of the solution are deduced the values of the potential barriers over which the particles have to jump in their relative rotational motion. A.

535.65

4749. A check on the standard observer data at 4358 Å. W. Harrison. *Brit. J. appl. Phys.*, **4**, 80–4 (*March*, 1953).

It has been suggested that the C.I.E. standard observer data for colorimetry may be seriously in error below 4600 Å. In this paper it is shown that the fluorescent lamp can be of particular value in checking the data at 4358 Å since fluorescent lamps and standard illuminants can form "metameric pairs" with different spectral distributions in the blue-violet and principally at 4358 Å. The check is made by visual comparison of the "metameric pair" and correlating the chromaticity so obtained for the fluorescent lamp with that obtained by computation from the spectral distribution. Measurements on warm white and daylight fluorescent lamps gave reasonable correlation with the C.I.E. data but not with the Wald–Gibson–Tyndall average data. A.

535.7 : 612.84

Physiological optics. *See Abstr.* 5259–60

535.822.6

4750. The effect of strain in objective lenses used for microscopical examination of metals under polarized light. B. W. Mott and H. R. Haines. *Proc. Phys. Soc.* [*London*] *B*, **66**, 302–6 (*April*, 1953).

It is shown that the effect of strain in objective lenses used for microscopical examination of metals under polarized light is similar to that of rotation of the analyser from the cross position. A procedure is described for assessing the relative strain effects in different objectives, and a method is given for compensating for the various anomalies due to stray polarization effects in the microscope. A.

535.87

4751. A new line board test for paraboloidal reflectors. W. Liben and B. Goldberg. *J. Opt. Soc. Amer.*, **43**, 347–52 (*May*, 1953).

A theoretical analysis is made of the Tschikolew, or line board test, for paraboloidal reflectors. This test has been used for many years as an indication of the quality of a paraboloidal reflector by virtue of the fact that a straight line is apparently imaged as a straight line if the reflector is perfect. It is shown that a straight line actually is imaged as a curve, but that if necessary test conditions are satisfied, the image can be approximated by a straight line. Because of the deficiencies of the Tschikolew straight-line test, a circular-line board test has been developed which utilizes a pattern of concentric circles. If the paraboloidal reflector is perfect, these circles are imaged as circles. Theoretical analysis indicates that, if the reflector is defective in any way, the image circle will be distorted. This distortion can be measured to determine the amount of deviation from the true paraboloid. Whereas the Tschikolew test is qualitative because of the difficulty in using it quantitatively, the circular-line board is shown to be suitable for simple quantitative work. The circular line board test can be made extremely sensitive by certain adjustments so that very small reflector defects can produce very large distortions in the image circle. A.

535.89

4752. A demountable flash-discharge tube for production of the Lyman continuum. W. R. S. Garton. *J. sci. Instrum.*, **30**, 119–20 (*April*, 1953).

Constructional and operating details are given for a high-intensity flash-discharge tube, used for generating a continuous emission spectrum which serves as background for the observation of far ultra-violet absorption spectra. A.

535.89

4753. Electrodeless metal-halide lamps. C. H. Corliss, W. R. Bozman and F. O. Westfall. *J. Opt. Soc. Amer.*, **43**, 398–400 (*May*, 1953).

The atomic spectra of high-melting point metals can be excited in electrodeless lamps if a volatile salt of the metal is introduced into the lamp together with a noble gas at a pressure of a few mm (Hg). The lamps are simply prepared from lengths of Pyrex or Vycor tubing, excited with microwaves and produce sharp spectral lines free from self-reversal. Lamps have been prepared which emit atomic spectra of Be, Ti, Fe, Ni, Cu, Mo and U. A.

535.89 : 545.822 : 621.3.014.31

4754. The automatic electrical ignition of the d.c. arc in spectrographic analysis. J. M. Nobbs. *Brit. J. appl. Phys.*, **4**, 118 (*April*, 1953).

In spectrographic analysis the striking of a d.c. arc between electrodes of the material under test is usually performed mechanically; in this paper apparatus is described which besides igniting the arc electrically by

means of a h.f. trigger spark re-ignites it automatically should it be accidentally extinguished or the arc current drop below a predetermined value during the period of exposure. A.

HEAT 536

536.2

4755. Radial-axial heat flow in regions bounded internally by circular cylinders. J. H. BLACKWELL. *Canad. J. Phys.*, **31**, 472–9 (*May*, 1953).

Two radial-axial transient heat flow problems have been solved for regions bounded internally by circular cylinders. They are not of the simple "product-solution" type and it is considered that they may have application in other fields of physics where the Diffusion Equation applies. The problems arose during investigation into "end-effect" in cylindrical thermal-conductivity probes. The solutions are obtained by integral-transform methods, two different types of transform being used in each solution. A.

536.2 : 541.124 : 532.72

Distribution of matter and the transport phenomena in the presence of a temperature gradient, and chemical reactions. *See Abstr.* 4645

536.21/.22

4756. An apparatus for measuring the coefficient of thermal conductivity of solids and liquids. T. A. MARSHALL. *Brit. J. appl. Phys.*, **4**, 112–14 (*April*, 1953).

A flat plate type of apparatus for measuring the coefficient of thermal conductivity of solids and liquids is described. Values which have been obtained for the coefficients of several typical cable dielectric materials over their working temperature range are given. A.

536.21 : 536.48

4757. The thermal conductivity of dielectric solids at low temperatures. R. BERMAN. *Advances in Phys.*, **2**, 103–40 (*Jan.*, 1953).

A review of experimental work, much of it carried out recently in Oxford, and an outline of its theoretical interpretation. In perfect crystals the thermal resistance is due to boundary scattering (at very low temperatures) and to Umklapp processes (at higher temperatures); in imperfect crystals the effects of impurities, displaced atoms and mosaic structure must also be taken into account. The theory and the measurement of the effect of each of these scattering mechanisms is discussed, and a final section deals with the properties of amorphous solids. The theory gives a reasonably satisfactory account of the general features of the observations, but there are a number of discrepancies, particularly at very low temperatures. 51 references. E. H. SONDHEIMER

536.212.2 : 536.48

4758. The thermal conductivity of metals at low temperatures. J. L. OLSEN AND H. M. ROSENBERG. *Advances in Phys.*, **2**, 28–66 (*Jan.*, 1953).

A review of recent experimental work. An outline of the present state of the theory of the electronic thermal conductivity of normal metals is followed by an account of experimental work on the thermal conductivity in the normal state, a brief section on the lattice conductivity, and sections on the thermal conductivity of alloys, the effect of a magnetic field, the thermal conductivity of superconductors and experimental techniques. The extent to which theory does and does not succeed in explaining experimental results is discussed, and suggestions for further experimental work are made. 74 references. E. H. SONDHEIMER

536.22/.

4759. Law of heat conductivity of liquids and vapours. A. K. ABAS-ZADE. *Zh. eksper. teor. Fiz.*, 2 *No.* 1 (7) 60–7 (1952) *In Russian.*

Refers to the law developed by Predvoditelev [*Zhur. fiz. Khim.*, **22** 339 (1948)], viz. $(k/c\rho)(M/\rho)^{1/3} = B(M/\rho)^{1/3} + I_W^{2/3}/I_V^{2/3}$ where ρ is the density, c the specific heat, and k the coefficient of heat conductivity of the liquid, while M is its molecular weight and I_W and I_V the adiabatic invariants of the gaseous systems and wave processes, respectively. When the right-hand side of the equation becomes a constant, the empirically derived relationship [Weber, *Report. d. Phys.* **22**, 116 (1886)] is obtained. By experimenting with water, benzene, toluene and xylene, the author has found that, in accordance with Predvoditelev's theory (1) the expression $(k/c)\rho^{-4/3} = a\rho^{-1/3}$ is a function of ρ and T, and (2) $k = b^{4/3}$, where b is a substance constant independent of the state, the latter relationship, in somewhat modified form, being applicable to compressed gases. The agreement with experiment is satisfactory. F. LACHMA

536.

4760. An electric method for measuring conductivity of heat through gases. S. M. ALY. *Proc. Egypt. Acad. Sci.*, **7**, 45–58 (1951).

Using the hot-wire method, the thermal conductivities of air, SO_2 and H_2S were found at temperatures in the range 0–50°C. R. H. DAVI

536.24 : 533.6

Basic methods in transfer problems. *See Abstr.* 46

536.25 : 536.42

4761. Processes of convection and evaporation. E. G. RICHARDSON. *Brit. J. appl. Phys.*, **4**, 65 (*March*, 1953).

The use of non-dimensional parameters to express the results of heat transfer experiments and analogies with other problems in fluid mechanics are discussed. Applications of fundamental processes in convection are instanced in the thermal precipitator and hot-wire anemometer. As examples of processes involving convectional evaporation the liquid drop and the wetted plate exposed to the wind and the application of such laboratory experiments in large-scale industrial plants and in meteorology are discussed.

536.25 : 551.513 : 523.6

4762. The instability of a layer of fluid heated below and subject to Coriolis forces. S. CHANDRASEKHAR. *Proc. Roy. Soc. A*, **217**, 306–27 (*May* 7, 1953).

Examines the stability of a horizontal layer of fluid heated below, subject to an effective gravity (g) acting (approximately) in the direction of the vertical and the Coriolis force resulting from a rotation of angu

velocity Ω about a direction making an angle θ with the vertical. It is shown that the effect of the Coriolis force is to inhibit the onset of convection, the extent of the inhibition depending on the value of the non-dimensional parameter $T = 4d^4\Omega^2 \cos^2\theta/\nu^2$, where d denotes the depth of the layer and ν is the kinematic viscosity. Tables of the critical Rayleigh numbers (R_c) for the onset of convection are provided for the three cases (*a*) both bounding surfaces free, (*b*) both bounding surfaces rigid and (*c*) one bounding surface free and the other rigid. In all three cases $R_c \to \text{constant} \times T^{\frac{1}{3}}$ as $T \to \infty$; the corresponding dependence of the critical temperature gradient ($-\beta_c$) for the onset of convection, on ν and d, is $g\alpha\beta_c = \text{constant} \times \kappa(\Omega^4 \cos^4\theta/d^4\nu)^{\frac{1}{3}}$ (κ = coeff. of thermometric conductivity and α = coeff. of volume expansion). The question whether thermal instability can set in as oscillations of increasing amplitude (i.e. as "over-stability") is examined for case (*a*), and it is shown that if $\kappa/\nu < 1{\cdot}478$ this possibility does not arise; but if $\kappa/\nu < 1{\cdot}478$, over-stability is the first type of instability to arise for all T greater than a certain determinate value. It further appears that these latter possibilities should be considered in meteorological and astrophysical applications of the theory. A.

536.421.4

4763. On the influence of drop volume on the supercooling of water drops and the significance of the freezing nuclei spectrum. W. RAU. *Z. Naturforsch.*, **8a**, 197–204 (*Feb.-March*, 1953).

It is shown that Heverly's relation between drop size and supercooling is inadequate, and from experiments made over the volume range 600 to 0·015 mm³ the author concludes that the experimental results can be explained in terms of 3 types of nuclei causing freezing in the neighbourhood of −4, −10–12 and −20°C respectively. J. M. HOUGH

536.424

4764. The phase transformation of cobalt as observed on single crystals. V. J. KEHRER AND H. LEIDHEISER, JR. Letter in *J. chem. Phys.*, **21**, 570 (*March*, 1953).

A spherical Co single crystal developed an oxidation pattern with hexagonal symmetry on heating in air at 350°–400°C, but with cubic symmetry on heating, after repolishing, at 450°–500°C. Repeating the experiment a number of times gave progressively better patterns with no recrystallization after the several passages through the transformation point (420°C). It was always the same set of {111} planes in the cubic form that became the {0001} planes in the hexagonal form. In all experiments a series of parallel bands, apparently intersections of {0001} planes with the surface, were observed running round the crystals and their nature and origin is discussed. A. D. LE CLAIRE

536.48

4765. Visual observations of the formation of bulk liquid from the helium II film. A. C. HAM AND L. C. JACKSON. Letter in *Phil. Mag.*, **44**, 214–16 (*Feb.*, 1953).

Helium film was allowed to flow down a conical surface whose perimeter decreased with height. Below the level where the perimeter became the same as the upper controlling perimeter, drops of bulk liquid formed. Their subsequent behaviour was in rough agreement with Frenkel's [Abstr. 93 (1949)] theoretical expectations. R. O. DAVIES

536.483

4766. A miniature helium liquefier-cryostat of cascade type. P. F. CHESTER AND G. O. JONES. *Proc. Phys. Soc.* [*London*] *B*, **66**, 296–301 (*April*, 1953).

The cryostat will cool from room temperature to 4·2°K in half an hour and enables continuous experiments to be carried out at or near this temperature, or at intermediate temperatures, for as long as required. It consumes only liquid oxygen and hydrogen from high-pressure cylinders, is extremely economical in its consumption of these materials and incorporates a number of new features which make its operation almost automatic after the starting-up period. A.

536.5

4767. Measurement of surface temperature. G. G. THURLOW. *Monthly Bull. Brit. Coal Utilis. Res. Assoc.*, **17**, 1–10 (*Jan.*, 1953).

A review of possible methods, including radiation, thermocouple, resistance thermometer and heat flow techniques. The thermocouple is usually the simplest but some care is needed. Optical instruments are used in inaccessible places, but flame and smoke can cause them to give misleading results. E. H. DOCK

536.521

4768. A full radiation pyrometer suitable for temperature measurements in the range 0° to 100°C. M. G. DAVIES AND H. KRONBERGER. *Atomic Energy Res. Establ.* [*Harwell*] *Mem. G/M* 144, 3 *pp.* (1952).

Diagrams of two forms of the instrument and full constructional details are given. A radiation receiver R is in a cavity in a conducting block C such that radiation from only the cavity walls and the surface S whose temperature is to be measured can fall on it. If the temperature of C is adjusted until the temperature difference between R and C is zero, the measured temperature of C is also that of S. The temperatures were determined by thermocouples. The front surface of R was blackened and the back polished. The instrument was used to measure the temperature of a rotor operating *in vacuo*. An accuracy of ½°C at 70°C is stated to have been obtained. S. WEINTROUB

536.531

4769. Measurements with small resistance thermometers for industrial and laboratory purposes. O. WINKLER. *Arch. tech. Messen, Issue* 205 (*Ref. V*212–2) 31–2 (*Feb.*, 1953) *In German.*

A note describing small resistance thermometers and their associated measuring bridges. The resistance at 0°C is 50 Ω. Over the range 0–50°C the scale is linear to about 4%. E. H. DOCK

536.62

4770. Adaptation of a four-element micro-calorimeter to thermogravimetric adsorption measurements. E. CALVET. *C.R. Acad. Sci.* [*Paris*] **236**, 486–8 (*Feb.* 2, 1953) *In French.*

A vapour-liquid thermal exchanger consists of a star-shaped cylinder of thin silver sheet supported by a central glass tube. This cylinder dips into the

liquid in a wider tube so that the vapour passes down the inside of the silver tube and up the supporting glass tube to the exit. Thereby equality of liquid and vapour temperatures is ensured. The calorimeter consists of four such units placed within holes in a copper block. Thermopile units are arranged so that the system can be used in a differential manner or in a special way for the adsorption measurements.

E. H. DOCK

536.631

4771. Concerning the low temperature specific heat of tellurium. W. De Sorbo. Letter in *J. chem. Phys.*, **21**, 764–5 (*April*, 1953).

Extends the one-dimensional Debye model of Tarasov (*Zh. fiz. Khim.*, **24**, 111 (1950)] to take account of interaction between the linear atomic chains in tellurium. The amended formula for the specific heat gives good agreement with experiment.

E. P. WOHLFARTH

536.633.3

4772. Experimental determination of the ratio of the specific heats of gases arising from the combustion of explosive powders. E. Lœuille. *C.R. Acad. Sci.* [*Paris*] **236**, 358–60 (*Jan.* 26, 1953) *In French.*

A method is outlined whereby measurements of the heat of combustion and specific volume of the gaseous products of combustion may be combined to obtain the mean ratio of the specific heats of the products. A table shows the good agreement between the values thus obtained and those calculated from the mean values, over the appropriate temperature range, of the individual products. F. E. HOARE

536.633.3

4773. The ratio γ of the specific heats of argon at high pressures. A. Lacam and J. Noury. *C.R. Acad. Sci.* [*Paris*] **236**, 589–90 (*Feb.* 9, 1953) *In French.*

For pressures up to 950 atm this is calculated from the ultrasonic velocities for 900 kc/s. The results agree with the thermodynamically determined values of Michels; which probably means no dispersion in monatomic gases even at fairly high pressures.

C. TURNER

536.633.3

4774. Note on the resonance method of measuring the ratio of the specific heats of a gas, C_p/C_v. H. W. Woolley. *Canad. J. Phys.*, **31**, 604–12 (*May*, 1953).

Experimental results of Clark and Katz and of Katz, Leverton and Woods obtained in a resonance method for determining the ratio of specific heats C_p/C_v have been recomputed with an improved formula for the mass effect of the gas. Improved agreement with values based on spectroscopic and *PVT* data is obtained for N, A, CO_2, N_2O and SO_2.

THERMODYNAMICS 536.7/.8

536.7

4775. Contributions to the axiomatic foundation of thermodynamics. I. An axiomatic interpretation of the idea "intensity parameter." I. Fényes. *Z. Phys.*, **134**, *No.* 1, 95–100 (1952) *In German.*

It is shown that the axioms of C. Carathéodory and T. Ehrenfest-Afanassjewa regarding temperature and thermal effect are valid not only in this special case but commonly connect the intensity parameter and the related thermodynamic effect. From this several important conclusions are drawn. F. E. HOARE

536.7

4776. The *H* theorem and unitarity of *S*. E. C. G. Stueckelberg. *Helv. phys. Acta*, **25**, *No.* 5, 577–80 (1952) *In French.*

If the entropy $S = S[w]$, $\delta S = -\Sigma_i g_i[w]\delta w_i$, is expressed as a functional of a probability distribution $w = w_i$, monotony of the derivative $(g_i - g_k)(w_i - w_k) \geqslant 0$, definiteness and normalization of the transition probability $A_{ik} \geqslant 0$, $\Sigma_k A_{ik} = \Sigma_k A_{ki} = 1$, are sufficient conditions to demonstrate Boltzmann's H theorem in the form $S'' - S' \geqslant 0$. Definiteness and normalization follow from the unitarity of the transition amplitude $S_{ik} \to S$, $S^\dagger S = \mathbf{1}$, $A_{ik} = |S_{ik}|^2$. Thus no contradiction can occur between thermodynamics and quantum theory. A.

536.7

4777. The physical principles of thermodynamics. R. A. Smith. *London: Chapman and Hall, xiii* + 280 *pp.*

Review in *Brit. J. appl. Phys.*, **4**, 95 (*March*, 1953). "The book follows the classical thermodynamic treatment and considers the main applications to physical and chemical phenomena, including chemical reactions and low temperatures."

536.7 : 532.51 : 530.162

Statistical mechanics, thermodynamics, and fluid dynamics of systems with an arbitrary number of integrals. *See Abstr.* 4623

536.7 : 539.3

Study of the heat evolved in the extension and relaxation of rubber. *See Abstr.* 5139

536.7 : 541.135.5

Stationary states with minimum entropy production in electro-chemical systems. *See Abstr.* 5164

536.71

4778. A new thermal equation of state. III. J. Himpan. *Z. Phys.*, **133**, *No.* 5, 647–60 (1952) *In German.*

A further modification of equations of state previously given [Abstr. 3554–5, 8148 (1952)]. The resulting equation is compared with experimental results for CO_2 over the pressure range 1 to $>10^4$ atm, with satisfactory agreement. F. E. HOARE

536.71 : 532.74 : 539.11

4779. On fusion as order-disorder transition. G. Borelius. *Ark. Fys.*, **6**, *Paper* 21, 207–12 (1953).

The structural entropy S_s of a condensed phase is expressed in terms of x the number of new sites, in addition to those at $T = 0°K$, which are made available for the atoms by thermal motion at non-zero temperatures. The nature of these new sites, not to be identified with vacancies, is described. Calculated relations between the structural energy U_s and S_s for Pb, Sn and Hg are then employed to plot for these metals curves of U_s against x. A distinct bend in these curves at intermediate values of x, which separates two linear portions at higher and lower

values of x, is regarded as being of fundamental significance for the fusion process, and is discussed in terms of clustering of the new sites. The analysis is formally similar to that employed by the author (1934) in treating order-disorder transitions in alloys.

A. D. LE CLAIRE

536.73 : 536.75

4780. Connection between the principle of retarded potentials and the second principle of thermodynamics. O. COSTA DE BEAUREGARD. *C.R. Acad. Sci.* [*Paris*] **236,** 666–8 (*Feb.* 16, 1953) *In French.*

A generalization of a recent note [Abstr. 1599 (1953)] concerning the variation of entropy of a system of emitters and absorbers with free photons during the emission of photons.

F. E. HOARE

ELECTRICITY 537

THEORY . ELECTRONS 537.1

537.12/.13

4781. On the Darwin method for the calculation of the magnetic moment of the electron and of the positron. V. S. VRKLJAN. *Period. math.-phys. astron.* [*Zagreb*] **7,** *No.* 2, 98–101 (1952) *In Serbo-Croat. Summary* (1 *p.*) *in German.*

The Darwin procedure is carried out by means of the matrices introduced in a previous paper [*Rad Jugosl. Akademije znanosti i umjetnosti*, **276,** 187–193 (1949)].

L. PINCHERLE

ELECTROSTATICS . DIELECTRICS 537.2

537.213 : 616–7

4782. The potential of two current point sources in a homogeneous conducting prolate spheroid. J. R. WAIT. Letter in *J. appl. Phys.*, **24,** 496–7 (*April*, 1953).

The potential distribution in a homogeneous spheroid due to an internal "source" and "sink" is calculated and its relevance to electrocardiography mentioned.

F. T. FARMER

537.213 : 621.317.321

4783. An isolating potential comparator. T. M. DAUPHINEE. *Canad. J. Phys.*, **31,** 577–91 (*May*, 1953).

A circuit is described by which electromotive forces can be compared accurately without making any direct electrical connection between them. A double-pole, double-throw chopper, having a condenser connected between the vibrating contacts, is used with a galvanometer or electronic amplifier to indicate any inequality between the e.m.f.'s without allowing any net flow of current between the circuits. Polystyrene condensers and mechanically driven choppers are used to minimize leakage and pickup problems. Potentiometric measurements may be made through this "isolating potential comparator" to $\pm 0{\cdot}1\ \mu V$. The error due to potential difference between the circuits is about 10^{-6} of the difference for 100 ohm circuits. An analysis of the method is given and optimum condenser and galvanometer characteristics determined. Magnitude and elimination of errors are discussed. The comparator is suitable for measurement or control of e.m.f. differences between thermocouples which are electrically connected through the tips. It also has many applications in resistance measurement and resistance thermometry.

A.

537.221

4784. A modified ionization method of measuring contact potential. W. R. HARPER. *Brit. J. appl. Phys.*, **4,** 111 (*April*, 1953).

The use of an insulated probe is described, for the case in which the relevant electrodes cannot themselves be used for the measurement.

A.

537.226 : 541.183.1

The dielectric behaviour of vapors adsorbed on silica gel. *See Abstr.* 5180

537.226.2

4785. Ferroelectricity. E. T. JAYNES. *Princeton: University Press*; *London: Oxford University Press* (1953) 146 *pp.* [*Investigations in Physics. I.*]

"The author provides here a general introduction to the subject of ferroelectricity. He includes a guide to the literature and a review of the various theories of $BaTiO_3$ that have been published, as well as an exposition of his own electronic theory."

537.226.2

4786. Dielectric relaxation time and association. I. Principle of the method of investigation exemplified by the cases of a non-associated and an associated dipole liquid (chlorobenzene, phenol). E. FISCHER. *Z. Naturforsch.*, **8a,** 168–76 (*Feb.–March*, 1953) *In German.*

According to Debye's formula the relaxation time (τ) of polar particles is proportional to the viscosity (η) and the particle volume. From measurements of τ it would be possible to estimate the effective volume of the particles and to draw conclusions about the degree of association. τ was calculated by measuring the heat developed in a liquid condenser under a high frequency potential (Steighöhen method). For a non-associated molecule (chlorobenzene) it was found that τ/η is independent of concentration. For associated molecules, such as phenol, τ/η increased with concentration, and a relation could be derived for the dependence of τ/η on the average number of associated molecules. A comparison with association numbers found by infrared measurements showed good agreement, except at very low concentration; this can be explained by the moment compensation in double molecules, of which no account had been taken. A discrepancy at higher concentration was caused by the mobility of the H bridge coupling of OH groups in long chains.

A. J. TAYLOR

537.226.2

4787. Dielectric relaxation time and association. II. Solutions and mixtures of weakly associated dipole liquids. E. FISCHER AND R. FESSLER. *Z. Naturforsch.*, **8a,** 177–86 (*Feb.–March.*, 1953) *In German.*

See also previous abstract. The same method was applied for substances which showed no dependence of dipole moment on concentration, but might still be

associated in a small degree. Anisole and aniline, both investigated in CCl_4, showed no association, but τ/η of nitrobenzene, benzonitrile and acetophenone increased with concentration; the degree of association was estimated. Some liquid mixtures were also investigated: in anisole-chlorobenzene there was no association, in chlorobenzene-nitrobenzene only the nitrobenzene molecules associated among themselves, as in a non-polar solution, but in acetone-chloroform mixtures a characteristic association between both kinds of molecules was observed. A. J. TAYLOR

537.226.2 : 548.0

4788. The dielectric properties and optical anomalies of single crystals of $BaTiO_3$. I. N. BELYAEV, N. S. NOVOSIL'TSEV, E. G. FESENKO AND A. L. KHODAKOV. *Zh. eksper. teor. Fiz.*, **23**, *No.* 2 (8) 211–16 (1952) *In Russian.*

Crystals (I) of $BaTiO_3$ obtained by double decomposition of $BaCO_3$ and Na_2TiO_3 were purer than those (II and III) deposited from solutions of $BaTiO_3$ in $(Na/K)_2CO_3$. The Curie point of (I) was near to that of the polycrystalline material. The domain structure of (I) was weak and disappeared on heating. Crystals remained single domains after cooling significantly below the Curie point. This stability is probably due to their acicular shape. Tan δ was inappreciable and ε showed no dispersion from 100 kc/s to 200 Mc/s. In batches (II) and (III), ε fell by 35% over this frequency range, and tan δ was somewhat larger. Some crystals of (II) and (III) had 15° thermal hysteresis in the appearance and disappearance of domain structure. For (II) in a constant field $\varepsilon_{||}$ was 380 and $\varepsilon_{\perp}$ 5500. Crystals from different parts of the same crucible did not always have identical properties. A. L. MACKAY

537.226.2 : 548.0

4789. Anisotropy of dielectric constant of ice. F. HUMBEL, F. JONA AND P. SCHERRER. *Helv. phys. Acta*, **26**, *No.* 1, 17–32 (1953) *In German.*

From large single crystals of ice, grown by a method published earlier [Abstr. 3920 (1952)], square plates were cut with the major surfaces either parallel or perpendicular to the optical axis. The dielectric constants and the loss angles were measured as a function of the temperature and of the frequency. The dielectric constant ε_c measured in the direction of the c-axis was found to be slightly larger than the dielectric constant $\varepsilon_{\perp c}$ measured in a direction perpendicular to the c-axis. The relative difference $(\varepsilon_c - \varepsilon_{\perp c})/\varepsilon_c$ at 1 kc/s is about 15% at −5°C, about 12% at −20°C and about 8% at −40°C. The dependence of the dielectric constants ε_c and $\varepsilon_{\perp c}$ and of the loss angles δ_c and $\delta_{\perp c}$ on frequency is similar to that found in earlier observations on polycrystalline ice. A.

537.226.2.08

4790. Accurate measurement of the dielectric constants of solutions. A. V. FEW, J. W. SMITH AND L. B. WITTEN. *Trans Faraday Soc.*, **48**, 211–15 (*March*, 1952).

The accuracy required in dielectric constant measurements to be used for the evaluation of apparent dipole moments in solution is discussed critically. Two forms of apparatus which meet the requirements of being capable of yielding relat measurements of dielectric constants accurate within ±0·0001 over the range 1·0–3·5 units described.

537.226

4791. Theory of dipole relaxation. Fundamen formalism. G.-J. BÉNÉ. *Arch. Sci.* [*Geneva*] **5**, *No.* 229–53 (1952) *In French.*

537.228.1 : 534.

4792. Theory of wave propagation in piezo-electr crystals. R. MEIER AND K. SCHUSTER. *Ann. Phy* [*Leipzig*] **11**, *No.* 8, 397–406 (1953) *In German.*

The laws of propagation of plane waves in piez electric crystals are derived, taking into accou electromechanical coupling. Using numerical valu quoted in the literature, the appropriate velociti and directions of vibration are deduced for the thr crystal systems of practical importance, viz. trigon (quartz), monoclinic ($Li_2SO_4.H_2O$) and tetragon (ADP). H. J. H. STARK

ELECTRIC CONDUCTION . CURRENTS 537

537.

4793. Remarks concerning electrical fluctuatio phenomena. H. WITT. *Z. Phys.*, **133**, *No.* 5, 661– (1952) *In German.*

Electrical fluctuations in insulators may be cause by a variation in the free electron concentration du to their statistically fluctuating recombination wit positive charges in the crystal. The theory of thi mechanism is developed and compared with experi ments on the α-particle bombardment of NaCl. C. A. HOGARTH

537.31

4794. On the initial stages of the process of establish ing an electric current in a layer lying on an ideally conducting foundation. O. A. SKUGAREVSKAYA. *Izv. Akad. Nauk SSSR Ser. Geofiz.*, *No.* 6, 28–36 (1951) *In Russian.*

The analysis is based on Maxwell's equations, with the usual conditions at the boundary between the two media. The final formulae permit the calculation of the initial stages of the process. MATHEMATICAL REVIEWS

537.31

4795. On the final stages of the process of establish ing an electric current in a layer lying on an ideally conducting foundation. O. A. SKUGAREVSKAYA. *Izv. Akad. Nauk SSSR Ser. Geofiz.*, *No.* 6, 37–49 (1951) *In Russian.*

A continuation of the work outlined in the preceding abstract. MATHEMATICAL REVIEWS

537.31

4796. On the establishment of an electric current in a nonhomogeneous stratified medium. A. N. TIHONOV AND O. A. SKUGAREVSKAYA. *Izv. Akad. Nauk SSSR Ser. Geofiz.*, *No.* 6, 50–5 (1951) *In Russian.*

Numerical and graphical results are given, based on the theory reported in the two preceding abstracts. MATHEMATICAL REVIEWS

537.311.31 : 539.234

4797. An experimental study of the electrical conductivity of very thin metallic deposits obtained by thermal evaporation. N. MOSTOVETCH. *Ann. Phys.* [*Paris*] **8**, *No.* 1–2, 61–125 (1953) *In French.*

Films of W, Ta, Mo, Rh, Pt, Fe, Ni, Cu, Au, Ag and Al, of thickness <100 Å, were deposited on quartz, glass and mica in a high vacuum. A complicated variety of effects was observed, among them (i) a decrease in resistance, due to adsorbed gas, which may be either reversible or irreversible, (ii) an exponential temperature variation of resistance, the apparent activation energies being of the order of $\frac{1}{10}$ eV, (iii) departures from Ohm's law: over a range of field strengths, the logarithm of the resistance is proportional to the square root of the mean applied field. The marked irreversible changes found in some films are ascribed, in accordance with existing ideas, to the presence of mobile atoms and to the thermodynamic instability of the films. The reversible effects are tentatively interpreted in terms of a conduction mechanism of semiconductor type, except for the departures from Ohm's law which are explained in terms of the effect of the electric field in lowering the potential barriers present at discontinuities in the structure of the film. 68 references. E. H. SONDHEIMER

537.311.32

4798. The electrical conductivity of MgO single crystals at high temperatures. A. LEMPICKI. *Proc. Phys. Soc.* [*London*] *B*, **66**, 281–3 (*April*, 1953).

The variation of electrical conductivity of MgO single crystals is measured as a function of temperature over the range from 300° to 1500°K. Heat pre-treatment is found necessary to stabilize the results at high temperatures. Assuming that the conductivity is electronic and intrinsic the energy gap between the full and conduction band is found to be 4·6 eV. A.

537.311.32 : 539.217

4799. Autodiffusion of K^+-ions in KCl crystals. H. WITT. *Z. Phys.*, **134**, *No.* 2, 117–26 (1953) *In German.*

Results are presented of measurements of the electric conductivity of, and auto-diffusion constant for K^+ ions in, KCl monocrystals with $SrCl_2$ admixtures, at temperatures of 400–600°C. The measured diffusion constants are always (for different proportions of admixture atoms, and for different temperatures) greater than those calculated from conductivity, the ratio being on the average $=2\cdot4$. No relationship is found between the temperature, or the content of foreign atoms, on the one side, and the difference between the measured and the calculated diffusion constant value. At 600°C, in the region of solid conduction [Eigenleitung] the difference between the diffusion constants is the same as in the region of spurious conduction [Störleitung]. F. LACHMAN

537.311.33

4800. Noise in semiconductors at very low frequencies. B. V. ROLLIN AND I. M. TEMPLETON. Letter in *Proc. Phys. Soc.* [*London*] *B*, **66**, 259–61 (*March*, 1953).

Various theories of current noise predict in general a $1/f$ variation with frequency but give different results as $f \to 0$. Measurements on pyrolytic carbon resistors, made by a new technique using a magnetic tape recorder running at very slow speed and then analysing the results by playing back at normal speed, show the $1/f$ law to hold at least to frequencies of the order 10^{-3}–10^{-4} c/s. C. A. HOGARTH

537.311.33

4801. The temperature dependence of drift mobility in germanium. R. LAWRANCE. Letter in *Phys. Rev.*, **89**, 1295 (*March* 15, 1953).

Measurements are reported for 2 ohm. cm single-crystal *n*-type Ge filaments over the range 100–360°K. For unstrained crystals the hole mobility μ_h increases with increasing temperature as $T^{-2\cdot3}$ and for strained crystals as T^{-3}. An apparent decrease in μ_h due to trapping effects is observed at low temperatures, but this can be to some extent annulled by increasing the emitter current and completely annulled by illuminating the crystal with light from a tungsten lamp. C. A. HOGARTH

537.311.33

4802. Low temperature conduction in extremely degenerate semiconductors. R. W. WRIGHT. *Proc. Phys. Soc.* [*London*] *B*, **66**, 273–7 (*April*, 1953).

The variation of conductivity of cadmium oxide with temperature has been measured over the temperature range 100°–800°K. It is found that the variations observed in the specimens used can be accurately predicted if it is assumed that all the electrons which are effective in the conduction process have energies above the bottom of the conduction band exceeding the characteristic energy of the lattice $h\nu$. This appears to be the first test of the mean free path theory for such electrons in ionic lattices. The properties of these electrons are markedly different from those with energies less than $h\nu$ which are usually met with in semiconductors. A.

537.311.33

4803. Temporary traps in silicon and germanium. J. R. HAYNES AND J. A. HORNBECK. Letter in *Phys. Rev.*, **90**, 152 (*April* 1, 1953).

Straggle in transit times for carriers in *p*-type silicon and *n*-type germanium at -80°C suggests the presence of shallow traps in addition to recombination centres. High-level illumination saturates the traps and eliminates straggling. From experiments the activation energies of traps in a specimen of *p*-type silicon are estimated to be 0·57 and 0·79 eV. G. F. J. GARLICK

537.311.33

4804. Semiconducting intermetallic compounds. R. G. BRECKENRIDGE. Letter in *Phys. Rev.*, **90**, 488 (*May* 1, 1953).

Presents preliminary remarks about the electrical properties of InSb, GaSb and AlSb. These substances appear to have similar properties to those of the elementary semiconductors of the fourth column of the periodic table, and are characterized by high charge carrier mobilities ($\sim 2\times10^4$ cm²/volt.sec for InSb). P. T. LANDSBERG

537.311.33

4805. Cyclotron resonances, magnetoresistance, and Brillouin zones in semiconductors. W. SHOCKLEY. Letter in *Phys. Rev.*, **90**, 491 (*May* 1, 1953).

This letter draws attention to the possibility of using cyclotron resonances at low temperatures in

weakly doped Ge to assist in the determination of the shapes of energy surfaces, and presents some calculations for the cases of spherical and ellipsoidal surfaces. P. T. LANDSBERG

537.311.33

4806. On the surface layer noise of semiconductors. W. M. Buttler. *Ann. Phys.* [*Leipzig*] **11**, *No.* 4–7, 362–7 (1953) *In German.*

The sources of noise in semiconductors are discussed, the most important being due to fluctuations in barrier height. A formula for noise power in terms of this variation, chemical potential and field strength is derived. C. A. HOGARTH

537.311.33

4807. On the surface layer noise of CdS single crystals. W. M. Buttler. *Ann. Phys.* [*Leipzig*] **11**, *No.* 4–7, 368–76 (1953) *In German.*

The formula developed previously (preceding abstract) is applied to the results with CdS under 4358 Å illumination. The noise current increases on illumination but the ratio of noise current to total current decreases on illumination. C. A. HOGARTH

537.311.33 : 538.632

4808. The adiabatic Hall effect in semiconductors. V. A. Johnson and F. M. Shipley. *Phys. Rev.*, **90**, 523–9 (*May* 15, 1953).

Calculations are carried out to determine the relative difference between the isothermal and adiabatic Hall coefficients of typical semiconductors. The isothermal Hall effect requires a constant temperature in the plane of the electric current flow and Hall field, whereas the adiabatic Hall effect is defined by the alternative requirements that the temperature gradient be zero in the direction of the electric current flow and the heat current be zero in the direction of the Hall field. The relative difference $(R_a - R_i)/R_i$ is studied for the (1) classical impurity semiconductor; (2) degenerate semiconductor; and (3) classical semiconductor at high temperatures. For the thermal and electrical conductivities characteristic of silicon and germanium, the relative differences are found to be of the order one per cent or less, thus indicating that it usually is not necessary to distinguish between the isothermal and adiabatic conditions in interpreting measured Hall values. Tabulated values are presented in such form that the relative difference may be readily calculated for any semiconducting sample of known electrical conductivity, thermal conductivity, and variation of carrier density with temperature. A.

537.311.33

4809. On the capacitance of the selenium rectifier. W. Oldekop. *Z. Phys.*, **134**, *No.* 1, 66–77 (1952) *In German.*

From a.c. measurements a thermally limited phase shift between current and voltage occurs, and if the rectifier is represented by a parallel *R–C* network, the phase difference appears as an additional negative capacity. This explains the abnormal decrease in *C* at high voltages, previously observed. C. A. HOGARTH

537.312 : 539.16

4810. A method for increasing the electrical resistivity of insulators under ionizing radiation. J. H. Coleman and D. Bohm. Letter in *J. appl. Phys.*, 22 497–8 (*April*, 1953).

Measurements on polystyrene during irradiatio with intense β-rays show that the usual fall in resis tivity is followed by a rise which continues for severa weeks. This change in character is permanent, an subsequent irradiation causes only relatively sma diminutions in insulation resistance. The treatmer is of value for material used in radiation measurin instruments. F. T. FARME

537.312.

4811. Photoconductivity of cadmium sulphid crystals at high temperatures. R. Caspary an H. Müser. *Z. Phys.*, **134**, *No.* 1, 101–5 (1952) *I German.*

537.312.5 : 538.63

4812. On the photo-magneto-electric effect. F Aigrain and H. Bulliard. *C.R. Acad. Sci.* [*Paris*] **236**, 595–6 (*Feb.* 9); 672–4 (*Feb.* 16, 1953) *In French*

The effect, discovered originally by Kikoïn and Noskov (1934), is demonstrated by placing a small rectangular semiconductor specimen in a magnetic field as for a Hall effect determination and then illuminating one large face. A p.d. is then found along the specimen. A simple theory is outlined for the p.d. obtained in terms of carrier mobilities, light intensity, diffusion constant, carrier lifetime and concentration, absorption coeffcient, and the specimen dimensions. Results are given for single crystal germanium, particularly for the variation of p.d with field and light intensity. C. A. HOGARTH

537.312.62

4813. Experiments on the superconductivity of contacts. I. Dietrich. *Z. Phys.*, **133**, *No.* 4, 499–503 (1952) *In German.*

Contacts between Ta electrodes covered with TiO_2 or CeO_2 layers 15 to 40 Å thick become superconductive. The dependence of the transition curves on thickness and current is investigated. H. LONDON

537.312.62

4814. On the question of superconductivity of disturbance-centre semiconductors (PbS). E. Justi and H. Schultz. *Z. Naturforsch.*, **8a**, 149–55 (*Feb.*—*March*, 1953) *In German.*

Evaporated layers of PbS with excess S or a small excess of Pb do not become superconducting, but show, with falling temperature, an increase in resistance towards infinity. With a larger excess of Pb, however, one always observes superconductivity. This begins with a steep decrease in resistance at the transition point of Pb which is ascribed to small depositions of the metal. After this follows a more or less extended temp. region in which the remaining resistance gradually disappears. In this region the resistance is independent of the measuring current. This indicates that the current is not carried by continuous threads of metallic lead but goes through the PbS proper, which has a concentration of carrier electrons of 10^{20} to 10^{21} cm^{-3}. Another explanation would be that the PbS forms contact layers between the Pb grains, as it is known that contacts involving a considerable thickness of insulating oxide can become superconducting [Holm and Meissner, *Z. Phys.*, **74**, 715 (1932)]. H. LONDON

537.312.8

4815. A relation between the Hall effect and the increase in the electrical resistance of bismuth at low temperatures. L. HALPERN. *Z. Phys.*, **133**, *No.* 4, 524–7 (1952) *In German.*

In the course of investigations on the change of resistance caused by Hall currents, the results of which are briefly quoted, it was found that, for polycrystalline Bi at liquid air temperatures, and in magnetic fields H between 100 and 700 Oe, the relative change in resistance $\Delta R/R$ is related to the Hall coefficient A_H by $\Delta R/R = C(A_H H)^2$, where C is a constant. E. H. SONDHEIMER

537.312.8

4816. The magnetoresistance effect in InSb. G. L. PEARSON AND M. TANENBAUM. Letter in *Phys. Rev.*, **90**, 153 (*April* 1, 1953).

Describes the preparation of a high-purity specimen of InSb (a semiconductor) and gives results of magneto-resistance measurements. These results indicate a high electron mobility and are in agreement with theoretical values based on the assumption of spherical energy surfaces. E. P. WOHLFARTH

537.323 : 536.48

4817. The thermo-electric behaviour of tin and silver at liquid–helium temperatures. G. T. PULLAN. *Proc. Roy. Soc., A*, **217**, 280–93 (*April* 8, 1953).

A new method, employing a superconducting galvanometer and requiring a temperature difference of only 0·01°K between the ends of the specimen, has been used to measure the absolute thermo-electric powers of tin and silver at liquid-helium temperatures. It has been shown that the thermo-electric power of tin vanishes abruptly at the superconducting transition temperature; this observation disagrees with the conclusions of Casimir & Rademakers (1947), who report a curious behaviour above the transition temperature which they hold to "foreshadow" the onset of superconductivity. The thermo-electric behaviour of metals in the normal (non-superconducting) state shows striking disagreement with the predictions of the free-electron theory. Thus, the thermo-electric power does not vary linearly with the absolute temperature, and for silver has a positive, instead of a negative, sign. The thermo-electric power is profoundly influenced by the presence of strains in the specimen, and by very small amounts of impurity, the temperature dependence becoming more nearly linear for impure or highly strained specimens. A marked anisotropy has been found in the thermo-electric behaviour of single crystals of tin. A.

537.363 : 542.8

4818. Continuous zone electrophoresis by crossed velocity fields in a glass powder column. The arrangement of a constant liquid flow and description of a simple pump apparatus. I. BRATTSTEN. *Ark. Kemi*, **4**, *Paper* 41, 503–22 (1952).

Refers to the problem of maintaining a constant velocity of flow in the separation column of the apparatus described by Svensson and Brattsten [*Ark. Kemi*, **1**, *Paper* 47, 401 (1949)], and reviews factors giving rise to velocity gradients. The choice of a suitable grain size and velocity is discussed on the basis of experiments. Describes a new model of the apparatus enabling the velocity of the liquid to be controlled either directly by means of adjustable pumps or indirectly by hydrostatic pressure control. It is designed for laboratory work, mainly for the separation of the blood-serum proteins. It has been in use for 2 years and works with great precision in the velocity range of 1–15 ml/h/cm². F. LACHMAN

ELECTRIC DISCHARGES 537.52

537.523.2 : 537.523.4

4819. The form of the negative pre-breakdown discharge in air at atmospheric pressure, for impulse voltages. W. PUCHER. *Ark. Fys.*, **6**, *Paper* 37, 383–93 (1953) *In German.*

Gives photographs of certain forms of pre-breakdown discharges, showing luminous narrow channels, and proceeds to discuss possible mechanisms whereby such channels may be formed. It is shown that the magnetic force is negligible, for the conditions considered, and space charge (electrostatic) effects are then discussed in some detail. The shape of electron clouds moving in regions where ionization by collision is small is calculated on the basis of certain assumptions. J. D. CRAGGS

537.523.4

4820. Breakdown of air, with negative impulses, in sphere-plane spark gaps. W. PUCHER. *Ark. Fys.*, **6**, *Paper* 36, 375–82 (1953) *In German.*

Gives data for gap lengths varying up to 120 cm and for sphere dia. of 6·2, 15 and 25 and 50 cm (atmospheric pressure). Corona threshold and sparking potentials are given separately. A derivation of breakdown potentials for sphere-plane gaps is given which enables calculations to be made for various gaps in terms of the uniform field value of electric gradient at breakdown. J. D. CRAGGS

537.523.4 : 537.525.4

4821. The behaviour of luminous electrode spots formed during spark discharges. R. D. CRAIG. *Rep. Brit. Elect. Res. Assoc., Ref. L/T*260, 19 *pp.* (1951).

The luminous spots formed on the electrodes, particularly the cathode, in 100-amp spark discharges of durations up to 10 μsec have been studied using electrodes of Mg, Cu, W and C in H, A and air, and with the pressure ranging between 100 and 800 mm of Hg. The cathode current-density for Mg, Cu and W has been estimated to be in the region 10^6 to 10^7 amp/cm² and that for C to be one order lower. The reason for the observed motion of the luminous spots over the cathode surface and the relation of the present work to the conditions in continuous arcs are discussed. A.

537.525.3 : 537.525.72 : 537.525.8

4822. Effect of light on the frequency of the r.f. oscillations in a.c. silent discharges. S. R. KHASTGIR AND P. S. V. SETTY. Letter in *Sci. and Culture*, **18**, 435–7 (*March*, 1953).

Gives an account of further expts. with ozonizer tubes containing hydrogen and iodine vapour, in which oscillations with frequencies ~4–5 Mc/s are observed. J. D. CRAGGS

537.525.5

4823. The [voltage] gradient in mercury vapour positive columns. T. WASSERRAB. *Z. Phys.*, **133**, *No.* 4, 532–6 (1952) *In German.*

Briefly discusses measurements of voltage gradients, mainly for low pressure discharges, in the light of formulae, prepared by various authors, which relate voltage gradient, tube diameter, and current by means of various constants. Values of the latter are given.

J. D. CRAGGS

537.529

4824. Directional effects in the electric breakdown of ionic crystals. E. L. OFFENBACHER AND H. B. CALLEN. *Phys. Rev.*, **90**, 401–9 (*May* 1, 1953).

A theory is proposed to explain the fact that in ionic crystals the paths formed as a result of electric breakdown lie along definite crystallographic directions which are independent of the direction in which the breakdown field is applied. The directional dependence of the collision probability for fast electrons is calculated on the basis of the directional asymmetry of the Brillouin zone of the phonons and the selection rules for electron-phonon collisions. For increasing temperature, or increasing impurity content, or decreasing overvoltage, the theory predicts the following sequence of breakdown directions: random [*R*]→[100]→[111]→[110]→[110] and [100]→[100]. A criterion is suggested for predicting the paths to be observed under any given conditions. A.

X-RAYS 537.531

537.531/.533 : 535.515 : 548.73/.74

4825. Under what conditions is interference double refraction [Interferenzdoppelbrechung] of cathode- and X-rays by crystals observable? K. ARTMANN. *Z. Phys.*, **133**, *No.* 5, 576–88 (1952) *In German.*

The refracted wave in a crystal consists of two superposed plane waves with slightly different wave vectors, which separate at a small angle on emergence from a prism-shaped crystal. Observation of the separation depends on the size of the crystals and the crystal-film distance; upper and lower limits for the crystal size are calculated for some particular cases. For 40 kV electrons the conditions are readily fulfilled, but for X-rays very large crystal-film distances (~500 cm) are required. A. J. C. WILSON

537.531 : 535.343

4826. Anomaly of the $M_{IV,V}$ absorption in heavy elements. J. FRIEDEL. *Proc. Phys. Soc.* [*London*] *A*, **66**, 333–40 (*April*, 1953).

The final state of the observed $M_{IV,V}$ absorption edge in heavy elements has a higher energy than the other (*K*, *L*, *M*) absorption edges. As suggested by Cauchois, this must be because, owing to selection rules, the transition probability of a 3*d* electron to the top of the conduction band is very small, and a strong absorption begins only when the ejected electron reaches the bottom of the 5*f* band. The corresponding energy is computed by the Wigner–Seitz method, and is in satisfactory agreement with the experimental data for the anomaly. As the anomaly disappears for the elements Ra to U, the conduction band of these elements must contain proportion of 5*f* states. An anomaly of the sam type is to be expected for the 4*f* band in the secon long period, and actually seems to be observed. A

537.531 : 535.345 : 531.71

4827. Measurement of thicknesses up to 10 mm with X-rays and Geiger counter. H. W. FRITZE *Stahl u. Eisen*, **72**, 943–5 (*July*, 1952) *In German.*

A hollow-anode tube with spherical ray propaga tion and fed by a controllable voltage is used fo thickness measurements of 1–10 mm metal plates b means of absorption of X-rays. Two rays are cu off from the radiation field; the one penetrates the test probe, the other a comparison plate. Afte penetration, the two radiation intensities are measured by Geiger counters, and their difference is registered. The variation of thickness with rolling temperature is considered by calculation. An improvement o measuring accuracy by stabilization of the voltage is a future objective of the author.

APPLIED MECHANICS REVIEW

537.531.85

4828. Evidence of a band structure in the Compton radiation from solids. K. ALEXOPOULOS AND G. BROGREN. *Ark. Fys.*, **6**, *Paper* 22, 213–22 (1953).

Describes experiments on the spectral distribution of X-radiation scattered from Be and C (graphite and diamond), which were designed to observe the structure of the Compton band. A. E. DE BARR

537.531.9

4829. Penetration and diffusion of hard X-rays: polarization effects. L. V. SPENCER AND C. WOLFF. *Phys. Rev.*, **90**, 510–14 (*May* 15, 1953).

Most calculations of X-ray penetration and diffusion neglect the polarization of the scattered photons. In this paper an investigation is made of the effect of polarization in a typical X-ray penetration problem. The Boltzmann equation for polarizable photons is expanded into suitable angular and spatial polynomial systems; and a calculation based on this Boltzmann equation is compared with a similar calculation which neglects polarization. The polarization effect increases the intensity of the 100–200 keV secondaries by a few per cent. A.

CATHODE RAYS . POSITIVE RAYS 537.533/.534

537.533/.534

4830. Dynamic pressure stage elements for projecting intense monokinetic corpuscular rays into gases at high pressure. B. SCHUMACHER. *Optik*, **10**, *No.* 1–3, 116–31 (1953) *In German.*

The theoretical basis of the method of Pauli for projecting an electron or ion beam into the atmosphere from a vacuum tube via one or more pressure stages is discussed. The critical conditions are determined and the construction of 3 pressure stage elements [Druckstufenstrecken] is described. Monokinetic beams with current strengths up to 0·5 mA are projected into air at atmospheric pressure or through a thin layer of air into a vacuum. The scattering in 1 mm of air is about the same as that in a 1 μ collodion film. H. J. H. STARKS

537.533

4831. Note on field emission. R. GOMER. Letter in *J. chem. Phys.*, **21**, 764 (*April*, 1953).

Draws attention to two references bearing on a recent paper by the author concerned with the velocity distribution of electrons in field emission [Abstr. 886 (1953)]. G. D. SIMS

537.533

4832. Corrected values of Fowler–Nordheim field emission functions $v(y)$ and $s(y)$. R. E. BURGESS, H. KROEMER AND J. M. HOUSTON. *Phys. Rev.*, **90**, 515 (*May* 15, 1953).

Corrected values are given for the function $v(y)$ which appears in the exponent of the Fowler–Nordheim equation for field emission from a metal. Values are also given for the function $s(y)$ which relates to the slope of logarithmic plots of the Fowler–Nordheim equation. A.

537.533

4833. Surface investigation of metals and non-metals with exo- and photoelectrons. J. KRAMER. *Z. Phys.*, **133**, *No.* 5, 629–46 (1952) *In German.*

It is known that spontaneous emission of electrons (exo-electrons) occurs at metal surfaces and is related to a shift in spectral limit of the photoelectron emission to longer wavelengths. It is shown that in non-metals the shift may be into the infrared. The exo-electron emission is affected by mechanical working of the metals and non-metals but the latter are also affected by irradiation, a "latent image" being formed on the surface, decaying away with time. Temperature studies show a complex change of the effect with temperature, giving a "spectrum" of activation energies similar to that of a phosphor "glow" curve.

G. F. J. GARLICK

537.533.7

4834. Influence of the Lorentz force on the space-charge waves in electron beams. J. LABUS. *Arch. elekt. Übertragung*, **7**, 88–94 (*Feb.*, 1953) *In German.*

It is pointed out that the Hahn–Ramo theory of space-charge waves is based on two conditions: (1) positive-ion space charge equal to the electron space charge; (2) infinite magnetic fields; which are not fulfilled in practice. The Brillouin magnetic field, however, permits one to realize a uniform cylindrical beam in which all the electrons have the same axial velocity, thus rendering the above conditions superfluous. The modifications introduced into the theory by the use of a finite magnetic field are discussed and it is shown that the propagation constants are unchanged unless fields of above 3000 gauss are required to produce the Brillouin flow. A. H. W. BECK

537.533.7

4835. The transmission of electrons through thin metallic foils. C. H. CHANG, C. S. COOK AND H. PRIMAKOFF. *Phys. Rev.*, **90**, 544–7 (*May* 15, 1953).

Experimental studies have been made on the relative transmission of positrons and negatrons in the energy range 50–750 keV through aluminium and platinum windows of an end-window-type G.M. counter. In qualitative agreement with the theoretical predictions that more scattering takes place in material having higher atomic number, a platinum foil having the same surface density as a corresponding aluminium foil shows lower relative transmission at any given energy even though the low energy cutoffs of the two windows are just about the same. Also in qualitative agreement with theory, a larger percentage of positrons than negatrons is transmitted at any given energy for the same platinum foil. Theoretical transmission curves, with an empirically determined constant, have been developed. These curves are in relatively good agreement with the experimental curves. A.

537.533.7 : 621.385.1.029.6

4836. An experimental study of the interaction by space-charge waves on an electron beam moving in crossed electric and magnetic fields. P. GUÉNARD AND H. HUBER. *Ann. Radioélect.*, **7**, 252–78 (*Oct.*, 1952) *In French.*

The main points of the theory of space-charge wave amplification in crossed fields are given and experiments on an interdigital line tube are discussed. When the beam is closed on itself, as in a magnetron, oscillations result. These oscillations are studied. Finally, experiments on the current reaching negative probes and on the electron temperature are described. These emphasize the close analogy between the electron temperature observed and the beam gain.

A. H. W. BECK

537.533.72

4837. Determination of an electron trajectory by successive integration. E. DURAND. *C.R. Acad. Sci. [Paris]* **236**, 364–6 (*Jan.* 26, 1953) *In French.*

A combination of step-by-step integration and iteration methods for the solution of second-order differential equations. The magnetic lens and the Glaser lens are taken as illustrative examples.

G. D. SIMS

537.533.72

4838. Determination of an electron trajectory by successive differentiation. E. DURAND. *C.R. Acad. Sci. [Paris]*, **236**, 471–3 (*Feb.* 2, 1953) *In French.*

A method of trajectory plotting based on successive differentiation of the trajectories defined by the paraxial ray equation is derived. This method has the advantage over standard plotting methods in that the required interval Δ can be determined *a priori* to yield the required accuracy. A. H. W. BECK

537.533.72

4839. Annular correction of a magnetic lens. P. HUBERT, P. GRIVET AND J. SEIDEN. *Physica*, **18**, 1136–8 (*Dec.*, 1952) *In French.*

A short coaxial coil is placed inside the lens coil, so that the 2 coils have a common mid-plane [see Abstr. 1054 (1952)]. Although correction was obtained in practice, the gathering power was low. This is attributed to the use of too small an angle of emission. J. C. E. JENNINGS

537.533.72

4840. A simple approximation formula for the field distribution along the axis of magnetic electron lenses with unsaturated pole pieces. H. BREMMER. *Optik*, **10**, *No.* 1–3, 1–4 (1953) *In German.*

Further discussion of a result due to Lenz [Abstr.

5455 (1951)] which depends only on the total flux and the ratio of pole spacing to aperture diameter. Formulae valid for various conditions are given, together with a table of an integral required in the calculation. A. H. W. BECK

537.533.72

4841. The magnetic lens as velocity analyser. F. LENZ. *Optik*, **10**, *No.* 1–3, 28 (1953) *In German.*

For background see Abstr. 3627 (1952) and *Optik*, **5**, *No.* 8–9, 499 (1949)]. The operation of magnetic lens velocity analysers can be improved by working at the edge of a caustic surface. Inelastic scattering can be made visible and the 15 V loss in an Al foil is demonstrated as an example. A. H. W. BECK

537.533.72

4842. Investigation of the asymmetry of magnetic pole-piece lenses with weakly sub-telescopic [unterteleskopischen] ray paths. F. LENZ AND M. HAHN. *Optik*, **10**, *No.* 1–3, 15–27 (1953) *In German.*

The analysis of the caustic figure allows the eccentricity to be calculated. A computation from a series of such figures gave an error of $0{\cdot}6\,\mu$ in the aperture radius and a corresponding restriction in resolving power to 3 mμ. When the error is of more complicated type than a simple departure from rotational symmetry the relationships between the caustic figure and the resolving power is more complicated. The theory given by Sturrock [Abstr. 7008 (1951)] gives good agreement with the results obtained by direct calculation. A. H. W. BECK

537.533.72 : 522.2 : 621.389 : 621.385.833

The electronic telescope. *See Abstr.* 4557

537.533.72 : 537.534.72

4843. Energy selection of charged particles by a magnetic field. J. W. GARDNER. *Canad. J. Phys.*, **31**, 459–68 (*May*, 1953).

Examines the problem of obtaining a sharply defined mono-energetic beam of particles from an omnidirectional, poly-energetic source without the use of slits. A magnetic field is suggested which will achieve this in the idealized case when the source and counter are of vanishingly small dimensions and the particles are confined to the median plane. The proportional spread in energy ($\Delta E/E$) of particles arriving at the counter, due to the finite dimensions of the source and counter and a small component of particle velocity out of the median plane, is then investigated. Finally some numerical estimates are made of $\Delta E/E$ and of the magnetic fields required in particular cases. A.

537.533.72 : 538.24 : 621.385.833 : 621.318.1.042

4844. Remanence in soft iron circuits of magnetic electron lenses. B. V. BORRIES, F. LENZ AND G. OPFER. *Optik*, **10**, *No.* 1–3, 132–6 (1953) *In German.*

The reasons for the discrepancy between the calculated and the observed focal lengths of soft iron magnetic lenses and the variations in focal length which occur in practice are discussed and illustrated by examples. Reproducible magnifications are only likely to be obtained by using permanent magnet lenses. H. J. H. STARKS

537.533.72 : 621.385.833

4845. The behaviour of an electron beam at entry to a coaxial magnetic field. L. BRUCK. *Telefunken Ztg*, **26**, 85–8 (*March*, 1953) *In German.*

In electron guns used for setting up Brillouin flow (cylindrical beam) the cathode must be shielded from the magnetic field. The problem of the transition region in the polepiece aperture is discussed using an (assumed) simple magnetic field variation. It is shown that the beam must be converging at entry to the field. It should converge, when the magnetic field is switched off, to a point where the field reaches 70% of the final, uniform, value. The final diameter, with field on, is less than the final diameter with field off. A. H. W. BECK

537.533.72 : 621.385.833

4846. On astigmatism in electron lenses. S. LEISEGANG. *Optik*. **10**, *No.* 1–3, 5–14 (1953) *In German.*

The caustic surfaces calculated by Glaser enable a simple test of the axial astigmatism to be made. The agreement between the calculated and experimental results is shown. Regenstreif's formulae for the caustic cross-section allow higher-order errors to be quantitatively investigated. The results lead to a simple test for a magnetic stigmator.

A. H. W. BECK (R)

537.533.72 : 621.385.833

4847. Adjustment of spherically corrected electron optical systems. R. SEELIGER. *Optik*, **10**, *No.* 1–3, 29–41 (1953) *In German.*

An electrostatic electron microscope is described which has 3rd-order spherical correction. The system comprises 2 ring lenses, 2 cylindrical lenses, a "stigmator" (an 8-electrode device for removing first-order astigmatism) and 3 "corrector" electrodes. The method of adjusting the potentials of the various components to obtain correction is described. At an angular aperture of $2{\cdot}6\times10^{-2}$, the use of the correcting system reduced the image defects to 6% of their original magnitude. H. J. H. STARKS

537.533.72 : 621.385.833 : 621.385.16.029.6

4848. Magnetic electron optics in long-beam amplifier tubes. M. MÜLLER. *Telefunken Ztg*, **26**, 95–101 (*March*, 1953) *In German.*

Discusses electron optical systems designed to produce Brillouin flow in solid cylindrical beams. The means of screening the gun region from the magnetic field are briefly described. The main part of the paper is devoted to the behaviour of the beam at entry to the field. It is shown that the beam must be convergent at entry to the field and that it should converge to the plane where $B = 0{\cdot}7\,B_{max}$. This is experimentally confirmed for several field shapes.

A. H. W. BECK

537.533.72

4849. Some characteristics of a low voltage electron immersion objective. W. W. H. CLARKE AND L. JACOB. *Proc. Phys. Soc.* [*London*] *B*, **66**, 284–95 (*April*, 1953).

An experimental investigation of the low-energy electron immersion objective in the range 20–70 V has revealed new features of interest in the study of beam distribution and characteristics. For example,

the beam current shows a saturation effect over a considerable portion of the modulation range; further, beam-trimming electrodes absorb maximum and minimum fractions of the cathode current for particular values of the ratio α of anode to modulator voltage. Using an arbitrary convention of measuring beam width, there appears to be a minimum beam radius at about 40 V for all beam angles, and an indication of a second minimum at higher energies and smaller beam angles. These and the marked change in distribution with voltage and with α are attributed to space charge repulsion effects. The simple space charge theory breaks down for the lowest energies; the limit for production of an axial beam lying at about 20 V. The trajectories in the presence of space charge indicate that even for the lowest emission densities, the "crossover" may be considerably displaced. A.

537.533.72 : 621.385.833

4850. An improved scanning electron microscope for opaque specimens. D. McMullan. *Proc. Instn Elect. Engrs, II*, **100**, 245–59 (*June*, 1953).

For abstract see Abstr. 8253 (1952).

537.533.72 : 621.385.833

4851. Constructional details of an electrostatic laboratory microscope. H. Bethge. *Optik*, **10**, *No.* 1–3, 137–42 (1953) *In German.*

Describes an instrument that can be made in the laboratory. One of the main features is the specimen carrier. The specimen is carried by a flange attached on each side by flexible tubing to the rest of the microscope body. Specimen movements are effected merely by shifting the flange:—up or down for focusing, sideways to select a suitable area for examination, or about an axis at right angles to the main axis for stereoscopy. There are no controls within the vacuum. J. THEWLIS

537.533.72

4852. The limits of validity of the calculation by successive approximations of the axial and radial focusing in a prismatic beta spectrometer. J. Lafoucrière. *Physica*, **18**, 1124–8 (*Dec.*, 1952) *In French.*

It is shown that double focusing is a general consequence of the stability of the stationary orbit. The limitations of the method of perturbations for the calculation of aberrations are demonstrated.

L. R. SHEPHERD

537.533.72

4853. A prismatic beta spectrometer with double focusing using ironless coils. A. Moussa. *Physica*, **18**, 1120–3 (*Dec.*, 1952) *In French.*

Two pairs of coaxial coils are employed, in order to satisfy the double focusing condition over a wide radial aperture. In the spectrometer described, a maximum power of 3·6 kW in 115 kg of Cu wire, is required to focus 1·3 MeV electrons on an orbit of radius 20 cm, with a transmission factor of 0·84% and a resolution of 1·2%. L. R. SHEPHERD

537.533.72

4854. On the use of the properties of the caustic in magnetic lens spectrometers. P. Hubert. *Physica*, **18**, 1129–35 (*Dec.*, 1952) *In French.*

In the uniform field (Tricker) spectrometer, the effect of stops is best studied by plotting $y = D \sin \alpha$ against $x = D \cos \alpha$, where $D = 2(H\rho)/H$ and α is the angle of emission. This procedure enables finite source size to be taken into account. It may be extended to the magnetic lens. The shape of the trajectories and the position of the caustic were determined experimentally, in the design of the spectrometer described in Abstr. 324 (1952). The results of Abstr. 1205 (1952) are summarized.

J. C. E. JENNINGS

537.533.72

4855. Double beta coincidence spectrometer. C. A. Mallmann. *Physica*, **18**, 1139–41 (*Dec.*, 1952).

A β-spectrometer design, employing a magnet in the form of a segmented torus, is described, and its particular suitability for coincidence work is pointed out. Some data on gathering power and resolving power are given. J. J. WILKINS

537.533.73 : 548.74

4856. Electron diffraction in lead iodide with a convergent beam. H. Pfister. *Ann. Phys*, [*Leipzig*] **11**, *No.* 4–7, 239–69 (1953) *In German.*

Discusses the intensity relationships in Kikuchi bands. The intensities of the strongest bands are in qualitative agreement with theory for thin crystals, but quantitative measurements show that the intensity is a little lower than calculated. This reduction in intensity is related to absorption changes, as is the transformation from light to dark as the crystal thickness increases. An appearance noted by Ackermann [Abstr. 3359 (1948)] is confirmed and explained. Other appearances are noted which are inexplicable according to usual ideas. J. THEWLIS

537.533.74

4857. Positron-electron scattering at 1·3 MeV. H. A. Howe and K. R. MacKenzie. *Phys. Rev.*, **90**, 678–82 (*May* 15, 1953).

Using an incident beam energy of 1·3 MeV, the ratio of electron to positron scattering on atomic electrons has been determined for the case where one-half the incident energy is transferred to the atomic electron. The measured ratio is $1{\cdot}82 \pm 0{\cdot}11$, which agrees with the theoretical ratio of 1·83, calculated from the expressions given by Møller and Bhabha when exchange effects are included. The theoretical ratio, excluding exchange effects, is 1·36. A.

537.533.8

4858. The high frequency end of the bremsstrahlung spectrum. H. J. Bowlden. *Univ. Microfilms Publ. No.* 3125 (1951) 46 *pp.* (*Photo-reproduction*).

Abstract in *Dissertation Abstracts*, **12**, *No.* 1, 86 (1952).

537.533.8

4859. The origin of secondary emission electrons. A. Lempicki. *Proc. Phys. Soc.* [*London*] *B*, **66**, 278–80 (*April*, 1953).

A secondary electron multiplier valve is used to determine the energy necessary to liberate secondary electrons from emitting surfaces. It is found that in the case of BaO and MgO secondary electrons originate from the valence band and not from impurity centres. A.

537.533.8 : 621.385.15

4860. The development of secondary emission multipliers. F. ECKART. *Ann. Phys.* [*Leipzig*] **11,** *No.* 4–7, 181–202 (1953) *In German.*

The phenomena of secondary emission are briefly surveyed and a critical study of the various types of multiplier and their characteristics is made. It is shown that a considerable improvement in the gridded multiplier using Ag–CsO–Ag surfaces is possible if the individual cathodes are highly insulated. Experimental multipliers show dark currents about two orders of magnitude less than those in the RCA931A when operated at the same stage voltage. Electron multipliers in which an electron lens is used to focus electrons from a large photo-cathode on to the first secondary cathode are briefly described. A bibliography of 83 items covering the whole field is included.

A. H. W. BECK

537.533.9

4861. Excitation and ionization functions for fast electron collisions. W. HANLE AND D. RIEDE. *Z. Phys.*, **133,** *No.* 4, 537–40 (1952) *In German.*

The excitation function for the 5016 Å line in He and ionization functions for He, A and Xe were measured up to ~15 000 V excitations by keeping the accelerating tube at a lower pressure than the ionization chamber. Agreement with theory was found.

W. J. SWIATECKI

537.533.9

4862. The radiation of a high energy electron in a constant magnetic field. M. NEUMAN. *Phys. Rev.*, **90,** 682–9 (*May* 15, 1953).

The quantum-mechanical radiation formula for an electron in a constant magnetic field—rigorous within the approximation of the first power of the fine structure constant—is derived. With it, the quantum effects for energies $E_{\text{BeV}} < 4(10^4/H_{\text{gauss}})$ are analysed and their importance assessed. The electron and the photon severally are subject to fluctuations which produce effects that are quite significant relative to the difference between the velocity of light and that of the electron, the decisive quantity at high energies. The net result however is that they are inconsequential in the domain investigated and that in its radiative aspects the system behaves—for all practical purposes—classically.

A.

537.533.92 : 537.564

The ionization by electron impact of excited hydrogen atoms and hydrogen peroxide. *See Abstr.* 4886–7

537.534

4863. Some observations on the operation of a Nier-type ion-source for a mass spectrometer. M. M. TODOROVIĆ. *Recueil Trav. Inst. Rech. Struct. Matière* [*Belgrade*] **1,** 95–101 (*July*, 1952) *In French.*

An experimental study of the effects of various parameters on the ion-current intensity and on observed isotopic abundance ratios is reported. Constructional details and operational characteristics of the filament are discussed.

J. J. WILKINS

537.534

4864. The "screening" of neutral particles in high voltage ion accelerator tubes. K. FIRTH AND D. R. CHICK. *J. sci. Instrum.*, **30,** 117–18 (*April*, 1953).

When using a r.f. type ion source in an electrostatic generator, a wide angle beam of neutral particles was found to be bombarding the accelerator tube electrodes. A method of preventing this bombardment in a modified form of tube is described.

A.

537.534 : 621.384.6

4865. Strong-focusing synchrotron—design and cost data. M. S. LIVINGSTON. *Nucleonics*, **11,** 12–15 (*Jan.*, 1953).

The strong-focusing principle depends upon the employment of *C*-magnets arranged around the perimeter of the particle track with the gaps facing alternately inwards and outwards, instead of all facing outwards as in conventional systems. The advantage of this lies in the fact that the frequency of the radial and vertical oscillations about the equilibrium orbit is greatly increased while their amplitude is greatly reduced. This makes it possible to use vacuum chambers of much smaller cross-section and correspondingly small magnet-gaps. The magnet pole-pieces have to be designed so as to give very large transverse field gradients. Data for the design of a 100 BeV accelerator based on the strong-focusing principle is given. The phase-stable synchronous energy-oscillations of the accelerated particles are discussed, and it is shown that in the 2 in. radial chamber width, which is required, a 10% momentum spread in the accelerated particles, can be accommodated, making it possible, for example, to tolerate large errors in the initial energy.

L. R. SHEPHERD

537.534 : 621.384.612

4866. The proton synchrotron at Birmingham University. I–II. *Engineer*, **195,** 271–4 (*Feb.* 20); 305–7 (*Feb.* 27, 1953).

A detailed description is given of the practical design and construction of the Birmingham synchrotron. The mechanical, electrical and radio engineering problems involved, with their solutions, are described. Particular attention is paid to the methods of achieving the close dimensional tolerances required.

J. H. FREMLIN

537.534.72

4867. Focusing properties of a combination of a magnetic field decreasing with the radius and a cylindrical electric field. D. FISCHER. *Z. Phys.*, **133,** *No.* 4, 455–70 (1952) *In German.*

Such an arrangement gives axial, radial and velocity focusing. By solving the equations of motion in an r^{-n} field the focusing angle, mass and velocity dispersions, the opening angle and the resolution are investigated and compared with the case $n = 0$. Greater intensities and double the resolution can be obtained with $n \neq 0$.

W. J. SWIATECKI

537.534.72

4868. A mass spectrometer with double directional focusing and velocity focusing. D. FISCHER. *Z. Phys.*, **133,** *No.* 4, 471–84 (1952) *In German.*

The characteristics of the arrangement considered in the preceding abstract were investigated experimentally and by using interchangeable pole-pieces they were compared directly with the case of a

uniform magnetic field and/or no electric field. Greater intensity and resolution were obtained in accordance with calculations. W. J. SWIATECKI

537.534.72

4869. Second-order focusing in a wedge-shaped magnetic field. J. GEERK AND C. HEINZ. *Z. Phys.*, **133**, *No.* 4, 513–23 (1952) *In German.*

It is shown that second-order focusing may be obtained in a homogeneous wedge-shaped magnetic field at the cusp of the caustic for first-order focusing, and the necessary conditions are derived and simplified by introduction of the angular magnification for a narrow beam as parameter.

A. O. STANESBY

537.534.72

4870. On a new mass spectrograph with anastigmatic image. R. F. K. HERZOG. *Z. Naturforsch.*, **8a**, 191–7 (*Feb.–March*, 1953) *In German.*

A combination of a spherical condenser and a homogenous magnetic field entered by the beam at a definite angle has the focusing properties of a spherical lens and gives also velocity focusing for all points of a photographic plate. The gain in sensitivity is by an order of magnitude. Experiments show that with careful adjustment the calculated sharpness of the point image can be attained.

W. J. SWIATECKI

537.534.74

4871. Proton–proton scattering for a nucleon isobar model. F. T. SOLMITZ. Letter in *Phys. Rev.*, **89**, 1295–6 (*March* 15, 1953).

The interaction energy suggested by the strong coupling ps.scalar charge-symmetric theory: $\frac{1}{9}(\tau_1 . \tau_2)(\sigma_1 . \sigma_2)V(r) + \frac{1}{27}(\tau_1 . \tau_2)S_{12}U(r)$ was fitted to low-energy data (using equal Yukawa V and U) and the scattering at 300 MeV calculated. Destructive $S - D$ interference at 90° gives results in sharp contradiction with experiment. W. J. SWIATECKI

537.534.74

4872. The cross-section in proton–proton scattering for small energies. H. ÜBERALL. *Acta phys. Austriaca*, **6**, *No.* 4, 246–9 (1953) *In German.*

By expanding the phases δ_l in powers of the wave number k, an expression for the scattering amplitude is obtained in terms of the radius and depth of the potential well instead of the unknown δ_l's.

W. J. SWIATECKI

537.534.75

4873. The energy loss of protons in metallic foils and mica. D. KAHN. *Phys. Rev.*, **90**, 503–9 (*May* 15, 1953).

The rate of loss of energy of 500 to 1300 keV protons in various metals and mica has been determined. Foils of Be, Al, Cu and Au were prepared by evaporation techniques, and the density of the foil was determined by weighing the amount of metal deposited on a known area. The energy loss rate $\Delta E/\Delta x$ was measured with a standard deviation of $< 3\%$. The energy loss curve was found to join smoothly to the previously measured curve for lower-energy protons ($50\text{ keV} < E < 350\text{ keV}$), and to approach the theoretical curves of Bethe and Bloch at the high-energy end. A.

537.534.75

4874. The energy loss of low energy protons in some gases. J. A. PHILLIPS. *Phys. Rev.*, **90**, 532–7 (*May* 15, 1953).

Experimental values for the energy loss of protons in H_2, He, N_2, O_2, A, Kr, H_2O, CO_2 and CCl_2 have been obtained in the region from 10 to 80 keV. The energy loss $(\Delta E/\Delta x)$ can be expressed for the elementary gases measured in terms of a single curve, with two constants $\Delta E/\Delta x = Lf(ME)$. The energy loss per atom is independent of the target density over the range 0 to 1·5 mm Hg., and the energy loss for compound gases is equal to the sum of their components. A.

DISCHARGE TUBES . COUNTERS 537.54

537.542

4875. Recent instrument developments in England. D. TAYLOR. *Nucleonics*, **11**, 40–3 (*March*, 1953).

The instruments described include a multi-purpose argon flow-type proportional counter, a new scaler using cold cathode decade scaling tubes, an automatic apparatus for analysing the configurations of coincidences in an array of 16 cosmic-ray counters, a health monitor incorporating a halogen-quenched G.M. counter used as a d.c. chamber, a flame proofing feature used in health physics instruments and a portable borehole logging equipment. L. R. SHEPHERD

537.542

4876. Quenching of photons in argon–CO_2 proportional counters. L. COLLI AND U. FACCHINI. *Physica*, **18**, 1272–9 (*Dec.*, 1952).

The excitation and quenching of A atoms are discussed on the basis of studies of pulse formation in proportional counters filled with A–CO_2 mixtures at different pressures. A. O. STANESBY

537.542

4877. Characteristics of BF_3 counters and precautions to be adopted in their use. J. SHARPE AND P. G. SALMON. *Atomic Energy Res. Establ.* [*Harwell*], *Rep. EL/R* 1073, 10 *pp.* (*Dec.* 3, 1952).

537.542

4878. The efficiency of the anthracene scintillation counter for low energy electrons. D. K. BUTT. *Physica*, **18**, 1142–8 (*Dec.*, 1952).

Efficiencies of 72–80% and 98% for 4 keV and 8 keV electrons, respectively, are deduced from experiments in which particular attention was paid to efficient light collection. The influence of electron back-scattering on the results is discussed.

J. J. WILKINS

537.542

4879. A high resolution coincidence instrument with scintillation counters. Delayed and prompt coincidences in the decay of ^{181}Hf. H. DE WAARD. *Physica*, **18**, 1151–6 (*Dec.*, 1952).

The instrument described uses two E.M.I. 5311 multipliers and stilbene crystals. The delayed coincidences from Hf^{181} indicated a lifetime of

$(1{\cdot}06 \pm 0{\cdot}03) \times 10^{-8}$ sec for the Ta^{181} isomeric state. The prompt coincidences (about 5 times less intense) were shown to arise from a γ–γ cascade. J. J. WILKINS

537.542 : 537.312.5

4880. Photomultipliers specially adapted for scintillation counters. E. MORILLEAU, H. DORMONT AND R. CHAMPEIX. *C.R. Acad. Sci.* [*Paris*] **236**, 474–6 (*Feb.* 2, 1953) *In French.*

537.542 : 537.533.72 : 621.385.833 : 621.317.351

4881. An electronic-optical process for the recording of the amplitude distribution of electrical impulses. H. WÄNKE. *S.B. Österr. Akad. Wiss., IIa*, **161**, *No.* 4–6, 151–73 (1952) *In German.*

The impulses are converted into rectangular pulses >1 msec duration, with amplitudes proportional to those of the original impulses. The rectangular impulses are applied to a vibration galvanometer, the deflections being recorded on a stationary photographic plate. The amplitude distribution is obtained by using a microphotometer on the plate. J. HUGHES

537.542

4882. Cerenkov detectors. J. V. JELLEY. *Atomics* [*London*] **4**, 81–90, 100 (*April*, 1953).

The Cherenkov radiation resulting from the passage of fast electrons or other particles through dielectrics is discussed; methods of detection and the uses of the detectors are reviewed. A bibliography is given. F. R. HOLT

537.542 : 621.318.572 : 621.317.79

4883. A time selector for measuring the time of flight of neutrons. P. DESNEIGES. Letter in *J. Phys. Radium*, **14**, 212–13 (*March*, 1953) *In French.*

The emergent beam of neutrons from a reactor is modulated by a mechanical interrupter. The instant of beam exposure triggers the time selector which then defines 10 consecutive equal intervals during the time the beam is on. During each interval a rapid 10-step "staircase function" is generated and applied to the deflecting plates of a switching tube [G. Pietri, *Vide*, **7**, 1113–22 (Jan., 1952)]. This tube acts as a coincidence detector between the 10 levels of the staircase and the emergent neutron impulses. The 10 outputs of the tube are further gated by a slow staircase function, each of whose levels corresponds to one of the 10 main intervals. The final counting is carried out by scales of 16 whose resolution time is <1 μsec. S. C. DUNN

537.542 : 530.145

4884. Application of the multiple scattering theory to cloud-chamber measurements. II. M. ANNIS, H. S. BRIDGE AND S. OLBERT. *Phys. Rev.*, **89**, 1216–27 (*March* 15, 1953).

The theory of multiple Coulomb scattering discussed in Pt I [Abstr. 7355 (1952)] has been applied to some specific problems in the analysis of data obtained with a multiplate cloud chamber. In particular, the problem of estimating the momentum (or, more exactly, the quantity $\Pi = pc\beta$) for a single particle is discussed, and a procedure for determining mass using scattering and residual range is given for the case of a group of particles homogeneous in mass. In the case of an inhomogeneous group of particles it is shown that the distribution function for values of the mean square angle of scattering in n plates can sometimes be used as a basis of separation into nearly homogeneous mass groups. In addition the distribution of the mean square angles provides an estimate of the error in Π or in the value of the mass. These methods are illustrated by a determination of the masses of the proton and meson using a mixture of these particles observed in a multiplate cloud chamber. In the theory developed in Pt I it was assumed that the probability for single Coulomb scattering goes abruptly to zero for angles greater than $\phi_0 = \phi_m a/r_n$, where ϕ_m is the screening angle as given by Molière, a is the Thomas–Fermi atomic radius and r_n is the nuclear radius. As a result of this assumption the mean value of the scattering angles, for means of order two and higher, remains finite as contrasted with the result of Molière or Snyder and Scott where the mean square angle of scattering is infinite. Consequently either the mean of the absolute values of the scattering angles or the r.m.s. angle of scattering can be used in the above applications. Both cases are given. The above assumption as to the cut-off angle for single scattering affects the value of the r.m.s. angle of scattering only slightly; it is shown, however, that the behaviour of the "tail" of the distribution function depends critically on the choice of ϕ_0. Consequently, the value of Π or of the mass is not greatly dependent on the particular theory of multiple scattering used, but the probability of scattering through angles large compared with the r.m.s. angle is. The difficulty of identifying a nuclear scattering by this method is emphasized. A.

IONIZATION . THERMIONICS 537.56/.58

537.561 : 539.164.92

4885. Energy per ion pair of gases and gas mixtures for α-particles. W. HAEBERLI, P. HUBER AND E. BALDINGER. *Helv. phys. Acta*, **26**, *No.* 2, 145–80 (*May*, 1953) *In German.*

Absolute values of the average energy loss W per ion pair of Po α-particles were measured for A, He, N_2, O_2, CO_2, using an ionization chamber with ion collection, pulse amplifier and pulse height analyser. The influence of recombination, self-absorption in the source of the α-particles and the frequency gain characteristic of the amplifier are discussed. The following values of W were evaluated: A (99·7%) $26{\cdot}25 \pm 0{\cdot}12$ eV; He (99%) $29{\cdot}6 \pm 0{\cdot}3$ eV; N_2 (99·9%) $36{\cdot}30 \pm 0{\cdot}15$ eV; O_2 (98·5%) $32{\cdot}17 \pm 0{\cdot}15$ eV; CO_2 (99·8%) $33{\cdot}5 \pm 0{\cdot}3$ eV. The purity of the gases used was determined by mass spectrometer. Relative values of the average energy loss W per ion pair of mixtures of two gases were studied. The experimentally determined dependence of W on the mixing ratio was compared with the behaviour expected on the assumption of independent ionization of the components. Deviations amounting to as much as 4% were observed. To understand these deviations one must assume the existence of interactions between the two gases. Considering only the influence of

secondary electrons and using a greatly simplified model of the ionization processes, the authors were able to account for the observed behaviour of W by a suitable choice of the parameters entering the calculations. A.

537.564 : 537.533.92

4886. The ionization and dissociation of hydrogen peroxide induced by electron impact. A. J. B. ROBERTSON. *Trans Faraday Soc.*, **48**, 228–34 (*March*, 1952).

The formation of the ions $H_2O_2^+$, HO_2^+, OH^+ and O^+ from H_2O_2 subjected to electron bombardment has been examined, to obtain data for a study of the reactions of HO_2, OH and O in the presence of H_2O_2. The results agree with the formula HOOH and give no evidence for a small proportion of a tautomeric form of formula H_2OO. Previous estimates of 13·6 eV for the ionization potential of the hydroxyl radical are confirmed. The ionization potential of hydrogen peroxide is $12{\cdot}1 \pm 0{\cdot}3$ eV. The minimum heat evolved in the formation of HO_2 from H and O_2 is equal to the ionization potential of $HO_2 - 235 \pm 9$ kcal, or 46 kcal assuming $I(HO_2) = 12{\cdot}2$ eV. A.

537.564 : 537.533.92

4887. The ionization by electron impact of excited hydrogen atoms. F. MANDL. *Atomic Energy Res. Establ.* [*Harwell*] *Rep. T/R*1006, 14 *pp.* (*Aug.*, 1952).

The cross-section for the ionization of atomic hydrogen in 2*s* and 2*p* states, by electron impact, is calculated. For the ($2p$, $m = \pm 1$) excited states the numerical computation has been carried out and a cross-section *v.* energy curve has been obtained. The calculation employs first-order perturbation theory, the ejected atomic electron being described by a Coulomb wave-function, the bombarding electron, before and after collision, by plane waves. Hence one expects this calculation only to be valid for large energies. This is also required in order to justify the fact that the interaction of the two electrons is neglected apart from it causing a first-order transition, and that the possibility of electron exchange is also neglected. On account of these approximations one cannot place much confidence in the energy *v.* cross-section curve at moderate energies. Comparison with the cross-section for the ground state and the classical formula of J. J. Thomson, however, suggests that the cross-section is appreciably larger (by about a factor 10) for the ($2p$, $m = \pm 1$) states than for the ground state. A.

537.583

4888. Thermionic properties of thoria. G. MESNARD. *Vide*, **7**, 1256–61 (*Nov.*, 1952) *In French.*

Cataphoretic coatings of thoria on tungsten wires were studied.. The activation process was studied in some detail and the variation of A and ϕ in Richardson's equation is plotted through the activation range. ϕ min $\simeq 1{\cdot}66$ eV for stabilized cathodes, in the range 2100–2200°K. The max. operating temperature for a reasonable life is about 2000°K. A. H. W. BECK

537.583

4889. Contribution to the study of thoria cathodes. G. MESNARD. *J. Phys. Radium*, **14**, 179–91 (*March*, 1953) *In French.*

A comprehensive account of the author's work [already described in Abstr. 334, 1145–6, 6215 (1951) and preceding abstract]. Includes cataphoretic coating on tungsten; activation phenomena and effects on the resistance, thermal radiation and emissivity; thermionic properties and their changes with time and temperature; the emission constants. Studies of the conductivity, thermoelectric effect and rectification lead to a semiconductor model for thoria.

A. H. W. BECK

537.583 : 537.533.1 : 621.385.032.216

4890. The velocity distribution of electrons of thermionic emitters under pulsed operation. I. Apparatus and measuring technique. C. G. J. JANSEN AND R. LOOSJES. *Philips Res. Rep.*, **8**, 21–34 (*Feb.*, 1953).

The construction of a tube for detecting the electron-velocity distribution of emitting surfaces, specially of oxide coatings at high current densities, is described. With the apparatus used in combination with this tube it is possible to measure the electron velocities with an accuracy of ~1%. Points of the i, V characteristics of the total emitting surface (8 mm²) and of the areas (0·03 mm²) the velocity spectra of which are observed can be determined with square pulses or d.c. Complete i, V characteristics of the total emitting surface can also be determined with pulses with a linearly sloping flank in a time interval of ~5μsec. Typical velocity spectra obtained from (BaSr)O, BaO and SrO coatings, and from the L-cathode are shown. With tubes of similar construction equipped with an L-cathode, peak voltages can be determined with an accuracy of ±1 V independently of repetition frequency or pulse width. A.

537.583 : 621.385.032.216

4891. Studies on oxide cathodes with resistive interface. A. P. WEBER. *Telefunken Ztg*, **26**, 123–7 (*March*, 1953) *In German.*

Results of microscopic examination of cathodes show that cathodes with high interface resistance are covered with a hard, glassy and markedly transparent layer. The roughening of the sleeve is independent of this layer and therefore Raudorf's theory that interface resistance is due to poor contact with the sleeve is unlikely to be correct. A. H. W. BECK

537.583 : 621.385.032.216

4892. The effects of oxygen on the electrical properties of oxide cathodes. A. A. SHEPHERD. *Brit. J. appl. Phys.*, **4**, 70–5 (*March*, 1953).

The mechanism of reduction of electron emission from oxide-coated cathodes by oxygen, and the recovery process after oxygen poisoning, have been studied using mass spectrometer techniques, showing that the formation of singly charged oxygen ions in the cathode coating plays a major part in the recovery process. Further studies employing diodes having a helical probe embedded in the cathode coating provided information on the reduction of coating conductivity by oxygen, the results being explicable on the basis of the Loosjes and Vink theory of conduction, which postulates two conduction processes in the cathode, one predominating below, the other above 700°K. The results obtained in both series of experiments are discussed, and a mechanism is proposed to account for the observed phenomena on the poisoning of emission and conductivity of cathode coatings by oxygen. A.

COSMIC RAYS 537.591

537.591

4893. A release mechanism for cosmic-ray-balloon experiments. S. v. FRIESEN AND G. LEIDE. *Ark. Fys.*, **6**, *Paper* 38, 395–7 (1953).

537.591.1

4894. Energy spectra of cosmic-ray photons and electrons from plastic scintillation counter measurements. C. N. CHOU. *Phys. Rev.*, **90**, 473–6 (*May* 1, 1953).

A new method of measuring high-energy photons and electrons is reported. Using an experimental arrangement consisting of G.M. counters and scintillation counters with large plastic scintillators, the number *v.* size distribution of cosmic-ray showers produced by photons and electrons in a lead block of one inch thickness was measured. From the results of shower theory the energy spectra of cosmic-ray photons and electrons at Chicago (600 ft above sea level and 51°N geomag. lat.) were deduced. The results of the present investigation show that in the energy range of 0·3–2·0 BeV, the differential energy distributions can be represented by a power law of the form E^{-s}, with $s = 2{\cdot}71 \pm 0{\cdot}13$ and $s = 2{\cdot}81 \pm 0{\cdot}13$ for the photon and electron components, respectively. The exponent s decreases considerably at energies below 0·2 BeV. An essential part of this investigation is to provide a suitable means of measuring the energies of energetic γ-rays or electrons, or the energy distribution of energetic γ-rays or electrons. The results show that scintillation counter arrangements consisting of large plastic scintillators are suitable instruments for these purposes. This method could also be applied to energy measurements of photons and electrons from high-energy accelerators. A.

537.591.15

4895. Further measurements of the shower production curve. H. THURN. *Z. Naturforsch.*, **8a**, 134–7 (*Feb.–March*, 1953) *In German.*

In continuation of previous work [Abstr. 1927 (1952)] it is shown that the (stationary) 3rd and the (pressure-dependent) 4th maximum in the yield *v.* (Pb) absorber thickness curve are produced by a non-ionizing component. The influence of the distance between absorber and counter was studied. For small separations the thickness of the absorber is not well defined (oblique penetration) and the resolution of the maxima is poor. Fe and C absorbers were also studied. W. J. SWIATECKI

537.591.15

4896. Unstable particles from penetrating showers. W. D. WALKER AND N. M. DULLER. Letter in *Phys. Rev.*, **90**, 320 (*April* 15, 1953).

In 500 cloud chamber photographs of penetrating showers originating in carbon only two examples of decays of neutral V particles were observed, compared with approximately 1 per 18 showers found by Fretter *et al.* using a similar apparatus for investigating showers produced in lead. One decay in flight of a charged V particle was observed in 1000 shower particles traversing an average distance of 15 cm. An investigation of the frequency of occurrence of close pairs of particles, which could be due to the decay ζ° particles coming from interactions in the carbon, showed that the number of such pairs was less than that expected by chance. H. ELLIOT

537.591.15

4897. The density distribution within two meters of large air shower axes. R. E. HEINEMAN AND W. E. HAZEN. Letter in *Phys. Rev.*, **90**, 496 (*May* 1, 1953).

The lateral structure of individual air showers at 280 m altitude has been investigated using an ionization chamber containing 20 independent collecting wires so that 20 density samples were taken for each shower. Some typical density distributions are given and evidence is presented for the existence of multiple cores generated by π° mesons. H. ELLIOT

537.591.5

4898. On the altitude dependence of the star size distribution and the energy spectrum of the nucleon component at $\lambda = 50$°N. M. TEUCHER. *Z. Naturforsch.*, **8a**, 127–34 (*Feb.–March*, 1953) *In German.*

An analysis of the statistics of over 10^4 stars classified according to the number of shower (N_s) and heavy (N_h) particles and obtained at 150, 3774 and ~20 000 m. For energies $> 10^9$ eV N_s is a better guide to the energy spectrum of the primary radiation. The results deviate, however, markedly from measurements of the primary spectrum at the top of the atmosphere. This may indicate that the energy per shower particle and the inelasticity of the process increase with energy. W. J. SWIATECKI

537.591.5

4899. Fluctuations and latitude effect of cosmic rays at high altitudes and latitudes. H. V. NEHER, V. Z. PETERSON AND E. A. STERN. *Phys. Rev.*, **90**, 655–74 (*May* 15, 1953).

Using a newly developed ionization chamber, which transmits its information by radio, simultaneous balloon flights were made from widely separated stations in the summer of 1951. Bismarck, North Dakota (geomagnetic latitude, λ_m, 56°N) was used as a base station. Four flights were made from shipboard going north from Boston and five were made from Thule, Greenland ($\lambda_m = 88$°N), simultaneously with those at Bismarck. In all, 28 successful flights were made by the two expeditions. In seeking to determine the geomagnetic effects on the low energy primaries, considerable information was gathered on the radiation that fluctuates from day to day. The following are the chief experimental findings together with some of the conclusions that may be drawn. (1) The fluctuations in the primary radiation at 90 000 ft were as much as 10% in a few days. (2) These were simultaneous (except as noted in the text) and very close to the same amount at the two stations. (3) The magnitude of the fluctuations at high altitudes was considerably larger than the geomagnetic effect between Bismarck and Thule. (4) The radiation that fluctuated contained both high (>15 BeV/c) momentum and low (down to 1·5 BeV/c) momentum particles. (5) There was a good correlation between the fluctuations in the radiation at high altitudes and the fluctuations in the neutron and meson components at ground level. (6) The fact that no particles fluctuated at Thule that did not also fluctuate

at Bismarck leads to the conclusion that there are few, if any, low energy particles coming in at Thule that are not also present at Bismarck, otherwise they too would be expected to vary. (7) From the manner in which the fluctuating radiation is absorbed in the atmosphere, it is concluded that the fluctuations cannot be due to heavy primaries alone. Rather it appears that the particles that fluctuate are of the same nature as the other incoming particles but have somewhat less energy per particle. (8) Varying magnetic fields of the geomagnetic axially symmetrical type are discarded as being able to produce the kind of fluctuations observed. A more satisfactory mechanism appears to be varying electric fields. (9) There was a negative latitude effect in the total ionization at intermediate altitudes (30 000 to 50 000 ft) at high latitudes. This is attributed to the greater importance of μ-meson decay in the warmer air of the stratosphere which exists at the more northerly latitudes. The temperature coefficient arrived at is $-0{\cdot}19\%$ °C^{-1}. (10) There was a positive latitude effect in the total ionization above 60 000 ft at high latitudes. Evidence is presented to show that this is not likely to be due either to atmospheric effects or to low energy particles admitted by the earth's magnetic field above 66°N. This increase is attributed to the shadow effect of the earth. (11) The absence of particles with momenta in the range 1·5 to 0·6 BeV/Zc (0·8 to 0·14 BeV for protons), shown by (*a*) a lack of increase of ionization at very high altitudes between geomagnetic latitudes 58° and 66°N, (*b*) the absence of an increase of area under the ionization-depth curve at latitudes north of $\lambda_m = 58$°N, and (*c*) the absence of any particles that fluctuate at Thule that do not also fluctuate at Bismarck, indicates a cutoff of the primary particles. (12) This cutoff is attributed to a general solar magnetic field. The magnetic moment required is $0{\cdot}65 \times 10^{34}$ gauss-cm^3 corresponding to a field at the solar equator of 19 gauss. (13) Any diurnal effect on cosmic rays due to such a magnetic moment would normally be hidden by the daily fluctuations of the primary particles. A.

MAGNETISM 538

538.083.9

4900. Arrangements for the study of magnetic fields by nuclear magnetic resonance. G.-J. Béné, P.-M. Denis and R.-C. Extermann. *Arch. Sci.* [*Geneva*] **5**, *No.* 6, 406–8 (1952) *In French.*

Small bobbins with 30 mm^3 of water are used as search probes in a magnetic field and the proton resonance frequency measures the strength. The beat patterns between two samples give the field gradient. D. H. WHIFFEN

538.114

4901. Concerning the exchange interaction of the external and internal electrons in ferromagnetism. V. L. Beshidze. *Zh. eksper. teor. Fiz.*, **23**, *No.* 1 (7) 55–9 (1952) *In Russian.*

A theoretical paper which discusses a many-electron exchange model for the external and internal electrons, after Vonsovskiĭ [*Zh. eksper. teor. Fiz.*, **16**, 981 (1946)]. Calculation of the splitting of the zero 3*d*-level causes an exchange electrical interaction of the internal 3*d* electrons with a system N of "magnetizable" external 4*s* electrons. The calculated splitting gives a linear function of the amount of arbitrary magnetization and the order of magnitude equal to 10^{-16}–10^{-15} ergs. W. BARDSLEY

538.114

4902. The zero-point susceptibility of a linear antiferromagnetic atomic chain. E. Ledinegg and P. Urban. *Acta phys. Austriaca*, **6**, *No.* 4, 257–87 (1953) *In German.*

An extension of the spin wave treatment of Bethe and Hulthén. Previous work is described and the linear integral equation giving the energy distribution function, due to Hulthén, is derived. The energy of the lowest state, E_0, is calculated for an infinite closed chain, giving $E_0 = -2NI\ln 2$, where I is the exchange integral. The integral equation is solved asymptotically for values of the energy close to E_0, and the zero point susceptibility is calculated. In contrast to Hulthén's approximate value of χ_0, independent of field, the more rigorous calculation given shows that χ_0 is a monotonically increasing function of field strength, H, $\chi_0 = (N\mu_B/H)\exp[-(2cI/\mu_B H)^{\frac{1}{2}}]$, where c is a given constant, so that $\chi_0 = 0$ for $H = 0$. E. P. WOHLFARTH

538.22 : 548.7

4903. Magnetic susceptibility of colored potassium chloride from 1°K to 300°K. C. V. Heer and C. Rauch. *Phys. Rev.*, **90**, 530–1 (*May* 15, 1953).

The magnetic susceptibility of potassium chloride crystals additively coloured with an excess of potassium was measured from 1°K to 300°K. The excess magnetic susceptibility or the susceptibility of the colour centres can be described by a temperature-independent term which is predominant at room temperatures plus a temperature dependent term which obeys Curie's law and predominates in the liquid helium temperature range. It is suggested that the portion of the susceptibility following Curie's law is due to *F*-centres, and the temperature-independent contribution is due to colour centre complexes. A.

538.221

4904. Experiments on the magnetic properties of metallic dysprosium. F. Trombe. *C.R. Acad. Sci.* [*Paris*] **236**, 591–3 (*Feb.* 9, 1953) *In French.*

Reports susceptibility measurements between 130° and 300°K at differing field strengths. The susceptibility exhibits a pronounced maximum at 178°K and is field-dependent near this temperature. It is concluded that the ferromagnetic and paramagnetic temperature regions are separated for this metal by an antiferromagnetic region. See also Abstr. 8116 (1952). E. P. WOHLFARTH

538.221

4905. Exchange frequency electron spin resonance in ferrites. J. Kaplan and C. Kittel. Letter in *J. chem. Phys.*, **21**, 760–1 (*April*, 1953).

Derives an expression for the r.f. susceptibility χ of a simple ferrite, for which the g values of the ions on the two sublattices are unequal, in the neighbourhood of the "exchange" resonance frequency f_0. The

values of χ and f_0 are estimated for Ni ferrite, giving $f_0 = 7 \times 10^{12}$ c/s (wavelength 40 μ). Experimental methods for observing the effect are suggested.

E. P. WOHLFARTH

538.221

4906. An interpretation of the magnetic properties of some iron-oxide powders. II. W. P. OSMOND. *Proc. Phys. Soc.* [*London*] *B*, **66**, 265–72 (*April*, 1953).

An earlier study [Pt I, Abstr. 2833 (1952)] of the magnetic properties of fine dispersed powders of acicular grains of magnetite and of γ-ferric oxide, derived by reduction and re-oxidation of dehydrated pigment oxides, has been revised, taking account of the probable cavities in the powder particles caused by the loss of oxygen during the chemical and structural transformations. Excellent quantitative agreement is now found between theoretical and measured values of coercivity, shape anisotropy alone seeming to be involved. Moreover, the qualitative agreement between theoretical values of intrinsic induction and remanence and those derived from actual powder dispersions is much better than with the earlier treatment.

A.

538.221

4907. The antiferromagnetic properties of mixed cobalt and manganese oxides. G. E. BACON, R. STREET AND R. H. TREDGOLD. *Proc. Roy. Soc. A*, **217**, 252–61 (*April* 8, 1953).

The paramagnetic susceptibilities of oxides of cobalt and manganese intimately mixed in various proportions have been measured as a function of temperature in the range 90 to 600°K. The mixtures are antiferromagnetic, and it is shown in particular that the observed Néel temperatures are linearly related to the atomic composition of the mixture. Neutron diffraction experiments on a sample of composition 50% MnO, 50% CoO show that the mixture is random and that the magnetic ordering below the Néel temperature is of the second kind. Anderson's molecular field theory [Abstr. 481 (1950)] of face-centred cubic antiferromagnetics is extended to the case of mixed systems, and it is shown that, by making reasonable assumptions, super-exchange can account for the observed variation of Néel temperature with composition. In other respects there is poor agreement between the theory and experiment, and it is suggested that the disagreement arises from the use of a molecular field treatment.

A.

538.221

4908. Reversal of spontaneous magnetization as a function of temperature in LiFeCr spinels. E. W. GORTER AND J. A. SCHULKES. Letter in *Phys. Rev.*, **90**, 487 (*May* 1, 1953).

Reports measurements of the spontaneous magnetization σ of mixed spinels $Li_{0.5}Fe_{2.5-a}Cr_aO_4$ as a function of temperature. For $1.0 < a < 1.6$, σ changes sign at a certain temperature, the value for $a = 1.25$ being about 310°K. The results are discussed on the basis of Néel's theory of ferrimagnetism. See also abstract following.

E. P. WOHLFARTH

538.221

4909. Anomalous behaviour of the *g* factor of LiFeCr spinels as a function of temperature. J. S. VAN WIERINGEN. Letter in *Phys. Rev.*, **90**, 488 (*May* 1, 1953).

Describes resonance absorption measurements on a mixed spinel $Li_{0.5}Fe_{2.5-a}Cr_aO_4$ ($a = 1.25$). The g factor was found to vary anomalously ("resonance curve") in the temperature range 250° to 350°K containing the temperature at which the spontaneous magnetization suffers a reversal in sign (see preceding abstract). The results are discussed on the basis of a general formula due to Kittel.

E. P. WOHLFARTH

538.221 : 539.11

4910. Ferromagnetism and order in nickel manganese alloys. G. R. PIERCY AND E. R. MORGAN. *Canad. J. Phys.*, **31**, 529–36 (*May*, 1953).

An investigation of ferromagnetism in nickel-manganese alloys containing up to 40 atomic % manganese has been carried out. Twenty alloys within this composition range were subjected to heat treatments such that the atomic arrangement within the alloys varied from disorder to a high degree of long range order. The degree of order of Ni_3Mn calculated from measured saturation magnetization using the atomic model of ferromagnetism was consistent with the value calculated from the ratio of measured integrated intensity of the (110) X-ray diffraction superlattice line to that of line (111). The relationship between saturation magnetization and concentration for the disordered alloys can be explained adequately by the existence of short range order. A value of 3·4 Bohr magnetons for the effective magnetic moment of manganese atoms in a nickel lattice was deduced.

A.

538.222

4911. Paramagnetic resonance in four double nitrate salts. R. S. TRENAM. Letter in *Proc. Phys. Soc.* [*London*] *A*, **66**, 118–19 (*Jan.*, 1953).

Values of $g_{\|}$, $g_{\perp}$ and the constants appearing in the Bleaney–Ingram formula [see Abstr. 3638 (1951)] are given, at 20 and 90°K, for the following ions in double nitrates of the type $3Mg(NO_3)_2.2Bi(NO_3)_3.24H_2O$: Mn^{++}, Co^{++} (for two distinct positions in unit cell), Cu^{++}, Gd^{+++}. Results are discussed.

L. PINCHERLE

538.222

4912. Investigation of proton magnetic resonance line width of sorbed water. T. M. SHAW AND R. H. ELSKEN. Letter in *J. chem. Phys.*, **24**, 565–6 (*March*, 1953).

Experimental results are given for the width $\Delta\nu$ of the narrow line attributed to protons in the adsorbed water in starch and egg albumin at 27°C as function of the water content. A comparison of the value of the average time τ during which a water molecule remains in the same equilibrium position, calculated from the heat of vaporization, and experimental values of $\Delta\nu$ shows that, for albumin in the range investigated, τ and $\Delta\nu$ are proportional.

L. PINCHERLE

538.222

4913. Paramagnetic resonance absorption: hyperfine structure in dilute solutions of hydrazyl compounds. H. S. JARRETT. Letter in *J. chem. Phys.*, **21**, 761–2 (*April*, 1953).

From the derivatives of the paramagnetic resonance curves in 0·002 M solutions, the hyperfine patterns, due to the interaction of the unpaired electron with

he nuclear moment of the N atoms, are deduced and hown to be consistent with the electron being qually shared by the two N atoms in 2, 2-diphenyl-1-picryl hydrazyl but unequally shared in N-picryl-9-aminocarbazyl and the Na salt of 2, 2-diphenyl-1-2, 4-dinitro-6-sulfo phenyl) hydrazyl. D. H. WHIFFEN

538.222

4914. Anomalous magnetic resonance absorption of copper acetate at 40 kMc/sec. H. ABE and J. SHIMADA. Letter in *Phys. Rev.*, **90**, 317 (*April* 15, 1953).

A continuation of previous work [Abstr. 8326 (1952)]. Information is given about the orientation of the crystallographic axes of the specimens, and values of the characteristic parameters of the spin Hamiltonian are deduced from the resonance absorption measurements. E. P. WOHLFARTH

538.222

4915. Magnetic saturation and apparent molecular fields of $MnCl_2 \cdot 4H_2O$. W. E. HENRY. Letter in *Phys. Rev.*, **90**, 492 (*May* 1, 1953).

Estimates the value of the molecular field by comparing curves giving the magnetic moment as a function of H/T, where H is the applied field, with the appropriate Brillouin curve ($J = S = \frac{5}{2}$, $g = 2$). The estimated value is about $1{\cdot}4 \times 10^4$ oersted over the temperature range investigated. The value of the exchange energy deduced is about $10^6/2z$ erg cm^{-3}, where z is the number of nearest neighbours. E. P. WOHLFARTH

538.24

4916. Magnetic after-effects of the initial permeability of the Barkhausen jumps. R. FELDTKELLER AND G. SORGER. *Arch. elekt. Übertragung*, **7**, 79–87 (*Feb.*, 1953) *In German.*

A general review of the three known types of magnetic after-effect phenomena. The Jordan and Richter after-effects are associated with the initial permeability whilst the Ewing after-effect (disaccommodation and magnetic creep) is associated with irreversible changes of magnetization. The Richter and Ewing after-effects are caused by the movement of impurity atoms (notably carbon) from one lattice position to another when the magnetization changes, but no physical cause of Jordan after-effect is known. A. E. DE BARR

538.242

4917. Gyromagnetic ratios of microcrystalline and macrocrystalline materials. S. J. BARNETT. Letter in *Phys. Rev.*, **90**, 315 (*April* 15, 1953).

Reports measurements on a 5–80 Permalloy specimen which is macrocrystalline, giving $\rho = (0{\cdot}994 \pm 0{\cdot}016)m/e$, compared with $(1{\cdot}048 \pm 0{\cdot}002)m/e$ for a microcrystalline specimen previously investigated. It is believed that crystal size differences in specimens investigated by the author on the one hand and by Meyer [Abstr. 4524 (1951)] on the other may account for the differences in ρ values obtained by the two investigators. E. P. WOHLFARTH

538.245

4918. Permanent magnet properties of cobalt-platinum alloys. D. L. MARTIN AND A. H. GEISLER. Letter in *J. appl. Phys.*, **24**, 498 (*April*, 1953).

Summarizes values of the magnetic characteristics (e.g. coercivity) of several Co–Pt alloys with differing compositions and previous heat treatments and compares the values with those found for powdered MnBi [Abstr. 320 (1953)]. E. P. WOHLFARTH

ELECTROMAGNETISM . ELECTRODYNAMICS 538.3/.5

538.3 : 532.51 : 523.877

4919. Generalized magneto-hydrodynamic formulae. C. O. HINES. *Proc. Cambridge Phil. Soc.*, **49**, *Pt* 2, 299–307 (1953).

The formulae for current and force which were employed in some of the initial work on magneto-hydrodynamic theory are not valid over the whole range of phenomena which the subject itself embraces. Generalized formulae, suitable for wider application, are derived by an extension of the magneto-ionic approach, and are applied to the simple case of plane-wave propagation in the direction of a primary magnetic field. The dispersion equation which results, as well as the basic current and force formulae, are reduced by approximations in a variety of limiting circumstances. Some earlier results are thereby regained and, in particular, the region of known validity of Alfvén's propagation relation is extended. A.

538.5

4920. On a criticism of the law of induction. L. LEVI. *Portugal. Phys.*, **3**, *No.* 2, 91–4 (1951) *In French.*

It is shown that an experiment of Blondel (1914) does not violate the law of induction, as has been thought [Abstr. 4223 (1950)]. L. PINCHERLE

538.51 : 621.3.011

4921. The derivation of vector potential from tables for scalar potential. J. J. SMITH. *Trans Amer. Inst. Elect. Engrs, I*, **71**, 169–74 (1952).

For abstract see Abstr. 8950 (1952).

538.52 : 550.837 : 621.3.013

4922. A conducting permeable sphere in the presence of a coil carrying an oscillating current. J. R. WAIT. *Canad. J. Phys.*, **31**, 670–8 (*May*, 1953).

The analysis is carried out for the problem of a current-carrying coil in the neighbourhood of a spherical body whose conductivity and magnetic permeability differ from the surroundings. The case is considered in detail where the frequency is low enough so that the primary field of the coil can be derived from a magnetic scalar potential. The secondary magnetic fields due to the sphere are then derived. The "in-phase" and "quadrature" components of the secondary field are discussed numerically and illustrated by graphs. The results have application to electrical prospecting. A.

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.566

4923. Optical methods for the calculation of diffraction patterns in the region of centimetre waves. H. SEVERIN. *Tech. Mitt. PTT*, **30**, *No.* 11, 347–56 (1952) *In German.*

The use of Green tensors makes it possible to cal-

culate the field anywhere in space, given either E_{tang} or H_{tang} on the boundary, on the basis of the vector extension of Kirchhoff's theory. It is shown, in the examples of the diffraction at a circular opening or at an opaque circular disk, how this approximate procedure should be applied to obtain best results, and rules are given. The formulae obey Babinet's principle for complementary screens. L. PINCHERLE

538.566

4924. Diffraction by a thick semi-infinite plate. D. S. JONES. *Proc. Roy. Soc. A*, **217**, 153–75 (*April* 8, 1953).

The form of the exact solution for the diffraction of a two-dimensional plane harmonic wave by a semi-infinite plate of thickness d is found. The solution involves constants which satisfy an infinite set of equations, and these equations are solved when d is small compared with the wavelength. It is shown that, in the neighbourhood of the shadow, the field is that of a single semi-infinite plane occupying the nearer face of the plate, whatever d, if terms of $O(R^{-\frac{1}{2}})$ are neglected, R being the distance of the point of observation from the edge. It is further shown that, when d is less than wavelength/10, the plate behaves as a semi-infinite waveguide whose sides project beyond the end of the plate by an amount $0{\cdot}11d$ together with, when the plane of polarization of the incident wave is perpendicular to the plate, a two-dimensional magnetic dipole at the end of the guide. When terms of $O(kd)$ can be neglected, it appears from this result and Hanson's (1930) work on a plate with a cycloidal end that the exact shape of the end of the plate is of no importance; the plate behaves as a semi-infinite waveguide. The extension of the theory to the diffraction by a thick plate of finite length is briefly discussed. The theory is also extended to incident scalar waves whose direction of propagation does not lie in the plane perpendicular to the plate and, from this, the field due to an incident electromagnetic wave is deduced. It is found that, for all values of d, the diffracted electromagnetic wave at any point is effectively travelling along a cone of semi-angle θ_0 and axis the nearer edge, where θ_0 is the angle between the edge and the direction of propagation of the incident wave. When d is small compared with the wavelength the plate acts as two parallel planes together with a line of magnetic dipoles at the end of the planes. A.

538.566 : 621.392.26

4925. A semicircular waveguide loaded by a semicircular slotted sheet. J. S. BELL AND J. M. BRUCE. *Atomic Energy Res. Establ.* [*Harwell*] *Mem. T/M57*, 6 *pp.* (1952).

An approximate theory for the structure is presented. When the dimensions are suitably chosen no wave other than the fundamental propagates in the frequency band of the latter. However, for a certain frequency band this fundamental wave can have either of two phase velocities for a given frequency, one of the phase velocities being associated with a negative group velocity. The frequency band referred to is in the region of the slowest waves and constitutes a difficulty in the use of the device for such waves. A.

538.566 : 621.392.26 : 621.396.677

4926. Wave guide arrays with symmetrical conductance functions. H. D. GRIFFITHS. *Canad. J. Phys.*, **31**, 520–8 (*May*, 1953).

Design formulae for nonresonant slotted waveguide arrays with a symmetrical conductance function are given. Methods are outlined for the calculation of the patterns from the asymmetrical near-field distributions produced by symmetrical arrays. A

538.566 : 621.396.11 : 621.392.26

4927. The propagation of electromagnetic waves along a conical helix with variable pitch. G. HELLGREN. *Chalmers Tekn. Högsk. Handl., No.* 130, 8 *pp.* (1953).

Theoretical investigation of the propagation of the electromagnetic waves along a conical helix with variable pitch. The helix constitutes an almost reflectionless device for small pitch angles ξ provided that the condition $\tan \xi = \text{const.} \times r$ is satisfied, r being the distance from the top of the cone. The reflection coefficient and the impedance characteristics have been evaluated using a convenient form of the Debye expansions of the Hankel functions.

Z. F. WOJNAR

538.566 : 621.396.677

4928. A Schmidt-camera for radio-waves. J. TUOMINEN. Letter in *Observatory*, **73**, 26–7 (*Feb.*, 1953).

It is pointed out that the use of spherical reflectors as radio aerials is equivalent to the use of Schmidt cameras on optical wavelengths, since the large size of the diffraction disk at radio wavelengths renders a corrector plate unnecessary. M. W. OVENDEN (R)

538.566.2

4929. Interaction of microwaves propagated through a gaseous discharge plasma. L. GOLDSTEIN, J. M. ANDERSON AND G. L. CLARK. Letter in *Phys. Rev.*, **90**, 151 (*April* 1, 1953).

Preliminary note reporting experimental observations of the interaction of two microwave signals (8600 and 9400 Mc/s) simultaneously propagated through gaseous discharge plasmas. The phenomenon is analogous to "cross-modulation" observed in the ionosphere. The duration of the effect after removal of the disturbing wave varies with the nature of the gas and its pressure; it is also observed strongly in the presence of a magnetic field at the gyro-frequency.

G. M. BROWN

538.566.2 : 621.396.11

4930. Tropospheric propagation well beyond the horizon. T. J. CARROLL. *Trans Inst. Radio Engrs Prof. Group on Antennas and Propagation, No.* 3, 84–100 (*Aug.*, 1952).

The internal reflection theory of tropospheric propagation and the conventional refraction theory are discussed. Calculated field strengths are compared with experimental data. The failure of the WKB approximation in these problems is also briefly considered. W. J. G. BEYNON (R)

538.566.2 : 621.396.11

4931. The diffraction of radio waves by the curvature of the earth. M. H. L. PRYCE. *Advances in Phys.*, **2**, 67–95 (*Jan.*, 1953).

Gives a simplified approximate derivation of the field at moderate heights and distances due to an oscillating electric dipole at moderate height above

he earth, taking into account the curvature and electrical constants of the earth. The method applies to both vertically and horizontally polarized waves. The results of previous workers are reproduced but are obtained more directly in a form suitable for easy computation. A.

538.566.2 : 621.396.11

4932. Tables of functions occurring in the diffraction of electromagnetic waves by the earth. C. DOMB. *Advances in Phys.*, **2**, 96–102 (*Jan.*, 1953).

Airy integral tabulations and others necessary for a practical field strength calculation based on the diffraction theory of Pryce are given (see preceding abstract).

W. J. G. BEYNON

538.566.2 : 621.396.11

4933. Propagation of plane electromagnetic waves past a shoreline. J. BAZER AND S. N. KARP. *New York Univ. (Washington Sq. Coll.) Math. Res. Group, Res. Rep. No.* EM-46, 64 *pp.* (*July*, 1952).

The problem of propagation of electromagnetic waves over a land-sea surface is treated. In particular the field is considered which arises from the diffraction of a plane wave (or ground wave) whose direction of propagation is normal and whose magnetic vector is parallel to the shoreline of a land-sea surface. The sea is treated as a perfect conductor, and at the air-land interface the customary impedance boundary condition is imposed. Mathematically, the problem of determining these fields involves the solution of a two-part boundary value problem for the time-reduced wave equation. Exact integral representations of this solution are obtained by means of techniques allied with those of Wiener and Hopf. Far field approximations are found in both the illuminated and shadow regions. Conditions are given which ensure the uniqueness of the field. In addition, some comments are made regarding the possibility of coastal refraction in our formulation.

A.

538.566.2 : 621.396.11

4934. Radio propagation over a flat earth across a boundary separating two different media. P. C. CLEMMOW. *Phil. Trans A*, **246**, *No.* 905, 1–55 (1953).

A theoretical investigation of the phenomena arising when vertically polarized radio waves are propagated across a boundary between two homogeneous sections of the earth's surface which have different complex permittivities. The problem is treated in a two-dimensional form, but the results, when suitably interpreted, are valid for a dipole source. In the first part one section of the earth is taken to have infinite conductivity and is represented by an infinitely thin, perfectly conducting half-plane lying in the surface of an otherwise homogeneous earth. The resulting boundary-value problem is initially solved for a plane wave incident at an arbitrary angle; the scattered field due to surface currents induced in the perfectly conducting sheet is expressed as an angular spectrum of plane waves, and this formulation leads to dual integral equations which are treated rigorously by the methods of contour integration. The solution for a line-source is then derived by integration of the plane-wave solutions over an appropriate range of angles of incidence, and is reduced to a form in which the new feature is an integral of the type

$$G(a, b) = be^{ia^2}\int_a^\infty \frac{e^{-i\lambda^2}}{\lambda^2+b^2}d\lambda,$$

where a and b are in general complex within a certain range of argument. The case when both the transmitter and receiver are at ground-level is considered in some detail. If the receiver is a large "numerical distance" from the transmitter, further simplification is possible; the results then agree with some previously given by Feinberg, whose method, however, was quite different. The practical adequacy of Millington's graphical technique of deriving attenuation curves of the ground-to-ground field is demonstrated, and the possibility of an increase of field-strength with distance is confirmed. This "recovery effect" is illustrated by a numerical example in which the phase curve is also shown to rise steeply just beyond the boundary, indicating a phase velocity in this region much greater than that in free space. A different approximate form of the general solution is obtained when the transmitter and receiver are sufficiently elevated; this is used to indicate the validity of the application of height-gain factors over an appreciable range of heights. In the second part the restriction that one of the earth media should be perfectly conducting is waived. A condition, usually met in practice, is assumed, namely, that the modulus of the complex permittivity of each section of the earth is large. Approximate boundary conditions are then likely to be valid, and their introduction makes possible an analytical treatment on the same lines as before. The solution is again reduced to a form only involving, apart from standard features, integrals of the type $G(a, b)$. Various features of the expression for the ground-to-ground field are examined; in a numerical example the attenuation and phase curves are given, the former being compared with the results of an experiment previously reported by Millington and the agreement shown to be good. The different approximate form of the solution when the transmitter and receiver are sufficiently elevated is briefly considered. Finally, some ramifications of the theory are outlined. A.

538.566.3 : 621.396.11

4935. The reflection of radio waves from an ionized layer having both vertical and horizontal ionization gradients. R. P. W. LEWIS. *Proc. Phys. Soc.* [*London*] *B*, **66**, 308–16 (*April*, 1953).

The approximation of ray optics is used to calculate the effects of simultaneous vertical and horizontal ionization gradients on the paths of radio waves in the ionosphere. Cases of practical importance are considered. A.

538.569.3 : 621.392.26

4936. The physics of microwave calorimeters. E. C. OKRESS. *Amer. J. Phys.*, **21**, 330–6 (*May*, 1953).

The electromagnetic reflection characteristics of a system of nonideal isotropic dielectrics in nearly ideal waveguides are formally developed. The general analytical results are applied to several cases of practical importance. Consideration is given to the manner of deriving optimum characteristics of flow calorimeters normally used for microwave measure-

ments of power. Other applications include the determination of the complex dielectric constant of high-loss liquid dielectrics. Considerations relating to bandwidth of microwave calorimeters are included. A.

MAGNETIC EFFECTS 538.6

538.614

4937. Variation of the magnetic rotatory power of carbon disulphide as a function of the temperature and of the physical state. R. DE MALLEMANN, F. SUHNER AND J. GRANGE. *C.R. Acad. Sci.* [*Paris*] **236,** 648–51 (*Feb.* 16, 1953) *In French.*

Whilst the molecular rotation of CS_2 liquid decreases by about 8% with increase of temperature from −80° to 20°C, the molecular rotativity, $[\Omega]_M$, is roughly constant. $[\Omega]_M$ decreases from 522 to 516 μR in the transition from the liquid to the vapour state. G. I. W. LLEWELYN

538.632

4938. Hall effect in beryllium and aluminium at low temperatures. E. S. BOROVIK. *Zh. eksper. teor. Fiz.*, **23,** *No.* 1 (7) 83–90 (1952) *In Russian.*

With fields of up to 20 000 oersteds and over a temperature range 2–200°K, the value for the Hall constant depends on temperature and field strength. Introduction of a quantity Ey/Ex, the ratio of the Hall field to the electrical field in the direction of current flow, reveals two types of Hall effect in metals. In one, the quantity increases linearly with increased field strength, e.g. aluminium, and in the other it decreases with field strength, e.g. beryllium. W. BARDSLEY

538.632 : 537.311.33

The adiabatic Hall effect in semiconductors. *See Abstr.* 4808

MOLECULAR AND ATOMIC STRUCTURE 539.1

THEORY OF SOLID STATE 539.11

539.11

4939. The virial theorem in free electron and generalized Thomas–Fermi models. N. H. MARCH. Letter in *Phil. Mag.*, **44,** 346–7 (*March*, 1953).

Shows that the virial theorem is satisfied for free electrons if exchange interaction is included and if the approximate distribution function is taken to be that obtained by minimizing the free energy. Some discussion is also given of the validity of the theorem in the Thomas–Fermi approximation in the many-nuclei case and at finite temperatures. E. P. WOHLFARTH

539.11

4940. Variational methods for periodic lattices and artificial dielectrics. C. FLAMMER. Letter in *Phys. Rev.*, **89,** 1298 (*March* 15, 1953).

Reference is made to Kohn's variational principle for the determination of the propagating solutions of the Schrödinger equation within a unit cell of a periodic lattice [Abstr. 7447 (1952)], and the electromagnetic analogue of this principle is obtained. P. T. LANDSBERG

539.11 : 539.133

4941. Vibration frequencies in diatomic molecules and in solid metals. E. C. BAUGHAN. *Trans Faraday Soc.*, **48,** 121–8 (*Feb.*, 1952).

An empirical generalization is pointed out between the Debye frequencies of metallic solids and diatomic molecular vibration frequencies predicted by a formula due to Guggenheimer. Some implications for the theory of metallic valency are discussed. A.

MOLECULAR STRUCTURE 539.13

539.13 : 533.25

The interaction of complex non-spherical non-polar molecules. *See Abstr.* 4660

539.13 : 537.534.72

4942. Mass-spectrometric study of oxygen polymers present in ozonized oxygen (O_3 and O_4). I. GRUNDLAND. *C.R. Acad. Sci.* [*Paris*] **236,** 476–8 (*Feb.* 2, 1953) *In French.*

Mass-spectrometric measurements of ozonized oxygen confirm the existence of a molecule O_4 about which there has been controversy hitherto. The conditions under which the molecule is observed (pressure 10^{-4} mm, accelerating voltage of ionizing electrons 70 V, which corresponds to $2{\cdot}7\times10^{-18}$ cal per electron) suggest a formula O_4 rather than $(O_2)_2$, as the bond between the atoms must be of an order different from Van der Waals attraction between two O_2 molecules. A. J. TAYLOR

539.132

4943. The existence of positronium chloride. L. SIMONS. Letter in *Phys. Rev.*, **90,** 165 (*April* 1, 1953).

Energy calculations have been made for the whole spectrum of $(Cle^-)e^+$, assuming a Hartree–Fock field for Cl^-. J. JACOBS

539.132

4944. Vibrational potential function of the molecule C_2F_4. A. MONFILS AND J. DUCHESNE. *C.R. Acad. Sci.* [*Paris*] **236,** 685–7 (*Feb.* 16, 1953) *In French.*

C_2F_4 belongs to the symmetry group V_h. In order to calculate the molecular constants a potential function was used containing terms for valence deformation as well as six coupling constants. Experimental values for the atomic distances and angles were used. Force constants and coupling constants were calculated. It is shown in comparison with similar molecules that the values found are reasonable. It is concluded that an assignment of 1340 cm^{-1} for a B_{1g} frequency corresponds better to the molecule than 1100 cm^{-1}, as believed by some authors. A. J. TAYLOR

539.132

4945. Formulation of isotopic splitting in terms of the reciprocal kinetic energy matrix. W. J. TAYLOR. Letter in *J. chem. Phys.*, **21,** 763–4 (*April*, 1953).

By the use of the normal modes of vibration of the

non-isotropic molecule as initial co-ordinates, the secular equation for the isotope is simplified. An equivalent equation was derived in terms of the reciprocal kinetic energy matrix. For small isotopic effects approximate solutions can be found, but these can be interpreted as exact physical quantities.

A. J. TAYLOR

539.132

4946. A new electronic state in benzene. J. S. HAM. Letter in *J. chem. Phys.*, **21**, 756–7 (*April*, 1953).

There is a considerable difference in oscillator strength of the 2600 Å band of benzene in CCl_4 and in a hydrocarbon solvent, and at liquid N temperature some bands scarcely appear when taken from benzene in a hydrocarbon glass. The benzene spectrum was taken from 2360 Å to 2750 Å in glasses containing CCl_4 and in glasses containing various hydrocarbons. A weak series is definitely shifted in the hydrocarbons. The differences are too big to be explained by solvent effects. It is possible that all bands observed belong to the same electronic transition, but this is improbable. Assuming they do not, the upper state is probably a triplet; possibly the singlet-triplet transition could become allowed because of spin-orbit coupling in the solvent molecules. A. J. TAYLOR

539.132

4947. The electronic structure of O_2. S. L. MILLER, C. H. TOWNES AND M. KOTANI. *Phys. Rev.*, **90**, 542–3 (*May* 15, 1953).

The magnetic hyperfine structure parameters which have been evaluated from an analysis of the spectrum of $O^{16}O^{17}$ are used to obtain information on the electronic structure of O_2. These values show that the unpaired electrons are primarily in $p\pi$ orbits but have approximately 2·5% s character. A.

539.132 : 535.343.4

4948. Forbidden transitions in diatomic molecules. III. New $^1\Sigma_u^- \leftarrow {}^3\Sigma_g^-$ and $^3\Delta_u \leftarrow {}^3\Sigma_g^-$ absorption bands of the oxygen molecule. G. HERZBERG. *Canad. J. Phys.*, **31**, 657–69 (*May*, 1953).

For Pt II, see Abstr. 8067 (1952). Two new forbidden transitions of the O_2 molecule have been found. They give rise to very faint absorption bands overlapping the much stronger forbidden $^3\Sigma_u^+ \leftarrow {}^3\Sigma_g^-$ bands described in Pt II. The upper states are identified as $^1\Sigma_u^-$ and $^3\Delta_u$ respectively, both of which arise from the same electron configuration as the known states $^3\Sigma_u^+$ and $^3\Sigma_u^-$. For the $^1\Sigma_u^-$ state the following vibrational and rotational constants have been determined: $T_e = 36678{\cdot}9_1$, $\omega_e = 650{\cdot}4_9$, $\omega_e x_e = 17{\cdot}03_6$, $\omega_e y_e = -0{\cdot}105_6$, $\omega_e z_e = -0{\cdot}0074_4$, $B_e = 0{\cdot}826_1$, $\alpha_e = 0{\cdot}0205_5$, $\gamma_e = -0{\cdot}00083_0$ cm^{-1}, $r_e = 1{\cdot}597 \times 10^{-8}$ cm. The constants are based on the assumption of a certain vibrational numbering which may have to be revised (increased). For the $^3\Delta_u$ state the data are quite fragmentary and only two rotational constants, $B_5 = 0{\cdot}817_7$, $B_6 = 0{\cdot}791_5$ and the one vibrational quantum, $\Delta G(5\frac{1}{2}) = 611{\cdot}1_6$, have been determined. The bands of the $^3\Delta_u - {}^3\Sigma_g^-$ system are very close to those of the $^3\Sigma_u^+ - {}^3\Sigma_g^-$ system and represent in all probability the analogue in free O_2 of the diffuse triplet bands of Wulf, Finkelnburg and Steiner ascribed to O_4. The positions of the new $^1\Sigma_u^-$ and $^3\Delta_u$ states agree closely with those predicted by Moffitt. Almost half of the unidentified features of the spectrum of the nightglow agree within 5 Å with the predicted positions of emission bands of the $^1\Sigma_u^- - {}^3\Sigma_g^-$ system. A.

539.132 : 535.343.4–14

The microwave absorption spectrum of O_2^{16} and $O^{16}O^{17}$. *See Abstr.* 4714

539.132

4949. Nuclear quadrupole spectra in two boron trialkyls. H. G. DEHMELT. *Z. Phys.*, **133**, *No.* 4, 528–31 (1952) *In German.*

Two frequencies in B^{10} and one in B^{11} were measured using $B(CH_3)_3$ and $B(C_2H_5)_3$ at liquid air temperatures. The ratio of quadrupole moments is $Q^{10}/Q^{11} = 2{\cdot}084 \pm 0{\cdot}002$. In both compounds the asymmetry parameter $(\phi_{xx} - \phi_{yy})/\phi_{zz}$ was $< 1\%$. The absolute values were estimated as $Q^{10} = 0{\cdot}105 \times 10^{-24}$ cm^2, $Q^{11} = 0{\cdot}051 \times 10^{-24}$ cm^2. W. J. SWIATECKI

539.132

4950. Nuclear quadrupole resonance of $HgCl_2$. A. BASSOMPIERRE. *C.R. Acad. Sci.* [*Paris*] **236**, 596–8 (*Feb.* 9, 1953) *In French.*

The interaction energy of the nuclear quadrupole of Hg and of Cl with the two electrons forming a Hg–Cl bond is calculated semi-empirically assuming a Heitler–London bond wave function. The corresponding resonance frequencies are predicted.

H. H. GREENWOOD

539.132

4951. The pure quadrupole spectrum of hexachlorobenzene. T. L. WEATHERLY, E. H. DAVIDSON AND Q. WILLIAMS. Letter in *J. chem. Phys.*, **21**, 761 (*April*, 1953).

The spectrum was investigated at liquid N temperature. Three lines were observed; the line frequencies corresponded to an average $|eqQ|$ of 76·884 Mc/s. Comparison with results for other chlorobenzenes shows an increase of quadrupole coupling with replacement of H by Cl. Similar effects were observed previously for CH_4 derivates.

A. J. TAYLOR

539.132

4952. Pure nuclear quadrupole spectrum of Bi^{209} in bismuth triphenyl. H. G. ROBINSON, H. G. DEHMELT AND W. GORDY. Letter in *Phys. Rev.*, **89**, 1305 (*March* 15, 1953).

The rather large quadrupole coupling constant indicates that the Bi bonding orbitals are not pure p, but have a significant s admixture (8 to 9%).

L. PINCHERLE

539.132

4953. Compressional energy and resonance energy. C. A. COULSON AND S. L. ALTMANN. *Trans Faraday Soc.*, **48**, 293–302 (*April*, 1952).

A careful analysis is made of the theoretical significance of the concept of resonance energy in aromatic and conjugated molecules, and of the possibility of calculating it. The discussion centres round the compressional energy, which arises on account of differences in bond lengths between the resonating molecule and the standard non-resonating reference structure. The conventional method of correcting for

these bond length changes derives from the pioneer work of Lennard–Jones, but it suffers from the disadvantage of depending on at least one quantity not well defined physically. For benzene, however, an alternative method is here developed, which is free from this criticism. A good agreement between the old and the new methods now provides a heuristic justification for the former. This is subsequently applied to some other molecules with consistent results. As a consequence of the corrections here introduced, values are proposed for the exchange and resonance integrals between two carbon atoms, which depend on the bond length, but are about 55 and 30 kcal/mole respectively. A.

539.132 : 535.375.5

Intensities in Raman spectra. I. A bond polarizability theory. *See Abstr.* 4731

539.133 : 535.343.4–14

Microwave spectrum and structure of SiD_3F and SiD_3Cl. *See Abstr.* 4715–16

539.133 : 541.651

4954. The out-of-plane deformation frequency of the NH group in the peptide link. H. K. KESSLER AND G. B. B. M. SUTHERLAND. Letter in *J. chem. Phys.*, **21**, 570–1 (*March*, 1953).

Partial deuteration of the NH bonds in different kinds of compound containing the peptide group causes a marked decrease in the intensity of the diffuse i.r. absorption band in the region of 700 cm^{-1}. In *n*-methyl formamide almost complete deuteration was achieved, and the above band disappears and a new band appears at 530 cm^{-1}. This reduction in frequency is exactly what would be expected for a pure NH deformation vibration free from interaction with other motions. The behaviour and properties of this band have been studied in oriented nylon and solutions of *n*-mono-substituted amides in CS_2. The striking resemblance of the 700 cm^{-1} frequency in the peptide link to the analogous OH deformation frequency in the alcohols is pointed out. The same out-of-plane NH deformation frequency has been identified in the lactams. J. IBALL

539.133

4955. The polarizability of molecules in strong electric fields. C. A. COULSON, A. MACCOLL AND L. E. SUTTON. *Trans Faraday Soc.*, **48**, 106–13 (*Feb.*, 1952).

The dependence of molecular polarizability upon field strength has been investigated theoretically. It is shown that the static polarizability increases with high field strength. This effect does not normally become important in macroscopically attainable fields, but it may be a significant factor with fields such as those in the vicinity of an ion or a dipole. A.

539.133

4956. Energy factors related to the configuration of flexible hydrocarbon molecules. A. R. UBBELOHDE AND I. WOODWARD. *Trans Faraday Soc.*, **48**, 113–21 (*Feb.*, 1952).

From observed specific heats and entropies the parameters in an empirical repulsion function for the mutual rotation of proximate CH_2 groups in a flexible polymethylene molecule can be calculated. When the same function is used to calculate the mean square length and radius of such molecules, a marked contraction is predicted with rising temperature. Yet such gas-kinetic data as are available on collision diameters suggest that these molecular parameters are not sensitive to temperature. Possible energy factors which could explain this apparent inconsistency are examined. A tentative modification for the potential energy function for rotation about single bonds is discussed. A.

ATOMIC STRUCTURE . NUCLEUS
ISOTOPES 539.15

539.152.1

4957. The pairing property of nuclear interactions. G. RACAH AND I. TALMI. *Physica*, **18**, 1097–100 (*Dec.*, 1952).

It is shown that the characteristics of pairing of nucleons considered by Mayer (1950) and Racah (1952) in *jj* and *LS* couplings are not confined to the ground state nor to the δ-potential. W. J. SWIATECKI

539.152.1

4958. A graphical representation of the energy valley surface based on the more recent isotope mass determinations. H. EWALD. *Z. Naturforsch.*, **8a**, 116–20 (*Feb.–March*, 1953) *In German.*

A projection of the bottom strip of the valley in an $(M–A, N, Z)$ diagram on to the $(M–A, N–Z)$ plane gives a vivid impression of the energy surface. The magic numbers $N = 2, 8, 20, 28, 50, 82, 126$ produce wiggles. The magic Z numbers seem to be less marked. W. J. SWIATECKI

539.152.1

4959. Nonexistence of stable isobars with odd mass number. S. SENGUPTA. Letter in *Phys. Rev.*, **89**, 1296–7 (*March* 15, 1953).

On the basis of strong attractive like-particle forces between paired nucleons, and the saturation property of nuclear forces [Fuchs, Abstr. 1857 (1939)] it is shown that for isobaric nuclei of odd mass number A, if any nuclide is β^--active, then all nuclei with higher N must also be β^--active; and if any nuclide is K-capturing or β^+-active, then all nuclei with higher Z are also K-capturing or β^+-active. Then for a particular odd A, there can be only one stable nuclide. A. O. STANESBY

539.152.1 : 539.172.13

4960. A survey of neutron and proton binding energies. N. FEATHER. *Advances in Phys.*, **2**, 141–84 (*April*, 1953).

Upper and lower limits on last-nucleon binding energies can be deduced in ~140 cases from Q values or thresholds in (n,γ), (d,p), (d,t), etc., reactions. In all some 600 binding energies are tabulated and compared with a smooth v. Weizsäcker formula. The discussion brings out the α-structure for $A < 40$ and gives mean values for the nucleon parity dependent terms. The recovery of "normal" binding energy after a closed shell is followed in detail for $126 \leqslant N \leqslant 136$ and $82 \leqslant Z < 92$. W. J. SWIATECKI

539.152.1

4961. Geometrical characterization of nuclear states and the theory of angular correlations. U. FANO. *Phys. Rev.*, **90**, 577–9 (*May* 15, 1953).

Degenerate states of nuclei, atoms, or radiations are identified by their tensor properties, that is, by the mean value of a set of multipole operators. A treatment is outlined which serves to construct angular correlation functions on a geometrical basis and provides a geometrical interpretation of known correlation formulae; the dynamics of specific nuclear reactions influences only a final averaging procedure. A.

539.152.1

4962. Excited states of even–even nuclei. G. SCHARFF-GOLDHABER. *Phys. Rev.*, **90**, 587–602 (*May* 15, 1953).

A general survey of excited states of even–even nuclei yields the following results: The nth excited state has usually a spin $I \leqslant 2n$. For $n = 1$, the assignment $I = 2+$ (even parity) is compatible with experimental results for 66 out of 68 nuclei investigated. For $n = 2$, of 26 nuclei investigated, about one-third have $I = 2+$, one-third $I = 4+$, and one-third miscellaneous spins of both even and odd parities. The energy of the first excited state plotted against the number of protons or neutrons in the nucleus varies rather smoothly and reaches maxima at closed shells. Wherever the first excited state is very low, e.g., in the rare earths region and for the heavy elements from thorium up, the one-particle model for odd A nuclei is likely to break down except for the ground state. The lack of isomers of odd proton nuclei below magic number 82 may be due to this fact. The average energy of the first excited state of the even–even core in this region is of the order of 0·1 MeV, whereas this energy is of the order of 0·5 MeV for the core of the corresponding odd neutron nuclei ($N < 82$). Isomerism in even–even nuclei is discussed. The results are compared with theoretical predictions derived from an extended j–j coupling model and from the liquid drop model of the nucleus. A.

539.152.1

4963. On the stability of heavy nuclei in the strong-coupling limit of the pseudovector meson theory. E. TRUCCO. *Helv. phys. Acta*, **26**, *No.* 2, 75–90 (1953).

Following closely a method introduced by Wentzel, the stability of a hypothetical heavy nucleus with pseudovector meson forces acting between the individual nucleons is investigated on the assumption of strong coupling. This is done by computing the total nuclear energy as a function of the nuclear volume, the calculations being restricted to the case of sufficiently small nuclear radii. The resulting energy v. volume curves are very similar to those found by Wentzel for the case of scalar interaction: they show no minimum which would correspond to a position of stable binding; also the nuclear forces do not exhibit any saturation effects. The model, therefore, does not adequately represent the basic properties of an actual nucleus. A.

539.152.2

4964. The spins of Li^6 and B^{10} in the shell model. N. ZELDES. *Phys. Rev.*, **90**, 416–19 (*May* 1, 1953).

The intermediate coupling approximation succeeds in explaining the different spins of Li^6 and B^{10}, where the LS coupling and the jj coupling fail. A.

539.152.2

4965. The quadrupole moment of Li^7. E. G. HARRIS AND M. A. MELKANOFF. *Phys. Rev.*, **90**, 585–7 (*May* 15, 1953).

The quadrupole interaction energy eqQ for Li^7 in Li_2 has been reported to be positive. In an attempt to determine $Q(Li^7)$ a calculation of q has been made using two approximate wave functions for Li_2. One of these is a Heitler–London function including inner shells and the other a twelve term variational function. The two functions lead to dissociation energies of 0·27 eV and 0·48 eV, respectively. The experimental value is 1·14 eV. The results of the two calculations differ in sign. The more accurate variational function leads to a negative q and consequently a negative value of $Q(Li^7)$. Unfortunately, the electronic and nuclear parts of q are nearly equal in Li_2 so that the magnitude and even the sign are still uncertain. A.

539.152.2

4966. The quadrupole moment ratio of I^{129} and I^{127} from pure quadrupole spectra. R. LIVINGSTON AND H. ZELDES. *Phys. Rev.*, **90**, 609–10 (*May* 15, 1953).

The pure quadrupole spectra for I^{129} and I^{127} have been observed in SnI_4 at 77°K and at 20°K. The nuclear quadrupole moment ratio has been determined to be $Q(I^{129})/Q(I^{127}) = 0{\cdot}701213 \pm 0{\cdot}000015$. A.

539.152.2

4967. On the determination of the nuclear spin from inelastic scattering. O. HITTMAIR. *Acta phys. Austriaca*, **6**, *No.* 4, 241–5 (1953) *In German.*

A general formula for the angular distribution from the reaction $X_1(a_1, a_2)X_2$ is simplified using the S-matrix and Racah-coefficients. When X_1, X_2 have spin 0 the spin L of the compound nucleus can be uniquely determined. The distributions for $L = \frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2}, \frac{9}{2}$ are given explicitly for the case when a_1, a_2 have spin $\frac{1}{2}$. W. J. SWIATECKI

539.153.4

4968. Electronic wave functions. X. A calculation of eight variational poly-detor wave functions for boron and carbon. S. F. BOYS. *Proc. Roy. Soc. A*, **217**, 235–51 (*April* 8, 1953).

For Pt IX, see Abstr. 4295 (1953). The eight wave functions which have been calculated show lower calculated energies than any others previously reported for the relevant P^2, P^4, D^2 states of B and the P^3, D^1, S^1, S^5, D^3 states of C. Thus according to the generally accepted criterion, they are the most accurate approximations to the true wave functions yet available. The calculations were performed according to the general principles described earlier in this series and the analysis performed by means of relations established in earlier theorems. In addition to the provision of new quantitative data the results are interesting, since they show in a qualitative way

the relative amounts by which functions of types different from the root function occur in the wave function. The root function, as it is convenient to call the dominant co-detor function, which has been found satisfactory in each case corresponds to the Salter function previously assigned on the basis of spectral analysis. A.

539.154.2

4969. Bibliography on americium. *Atomic Energy Res. Establ.* [*Harwell*] *Bibl. I/B* 86, 5 *pp.* (1952).

Fifty-six unclassified reports and 27 published papers are listed.

539.155.2

4970. A method of measuring isotopic abundances with a mass spectrometer in the presence of residual peaks. M. M. TODOROVIĆ. *Recueil Trav. Inst. Rech. Struct. Matière* [*Belgrade*] **1,** 111–13 (*July,* 1952) *In French.*

By varying the pressure in the ion source the intensity from the sample can be distinguished from the (constant) contribution of a contamination.

W. J. SWIATECKI

539.155.2 : 531.756

Determination of low concentrations of heavy water. *See Abstr.* 4630

539.155.2 : 539.172.4

4971. Relative abundances and neutron capture cross sections of the neodymium isotopes. W. H. WALKER AND H. G. THODE. *Phys. Rev.,* **90,** 447–8 (*May* 1, 1953).

A double-focusing mass spectrometer has been used to determine the relative isotopic abundances of naturally-occurring neodymium and the relative isotopic neutron capture cross-sections. Allowance for isotope fractionation, an effect which is only noticeable under certain experimental conditions, has been accomplished by an averaging technique. The relative abundances are compared with the results previously published. The relative cross-sections are normalized to a value of 48 barns for the capture cross-section of normal neodymium. The resulting isotopic cross-sections are in satisfactory agreement with the recently published results of Pomerance. A.

539.155.2 : 541.135

4972. On the continuous, cascade-type enrichment in isotopes. R. WALEN. *Recueil Trav. Inst. Rech. Struct. Matière* [*Belgrade*], **1,** 35–67 (*July,* 1952) *In French.*

Discusses the possibility of designing a continuous-operation electrolytic setup for obtaining high concentrations of D_2O. The general theory of a cascade-type separator with recovery is adapted to the specific case of water electrolysis, for which the coefficient of separation is ~1 and varies during the process. The following systems have been taken into consideration: (1) simple closed-system electrolyser (without recovery), (2) continuously working chain of such simple electrolysers, (3) constant-level electrolyser, and (4) chain of constant-level electrolysers. Expressions and formulae derived are illustrated by numerical examples. The expected technical snags of real systems are discussed. F. LACHMAN

RADIOACTIVITY . α-, β- AND γ-RAYS 539.16

539.16.08

4973. Absolute calibrations of high-energy β-emitters with the 4 π-counter. F. G. HOUTERMANS, L. MEYER-SCHÜTZMEISTER AND D. H. VINCENT. *Z. Phys.,* **134,** *No.* 1, 1–8 (1952) *In German.*

Various methods of absolute calibration are described. The authors used a 4 π-counter with Na^{24}, P^{32}, K^{42} and Pr^{142}. Necessary corrections are described. Results agreed well with AERE (Harwell) figures. F. R. HOLT

539.16.08

4974. Absolute calibrations of low-energy β-emitters with the 4 π-counter. L. MEYER-SCHÜTZMEISTER AND D. H. VINCENT. *Z. Phys.,* **134,** *No.* 1, 9–20 (1952) *In German.*

Sources of error are discussed. The isotopes measured were S^{35}, Zn^{69}, $Sr^{90} + Y^{90}$, I^{131} and Tl^{204}. Results agreed well with AERE (Harwell) figures. Coincidences found in the counter were mainly spurious. F. R. HOLT

539.16.08

4975. A photographic method for the quantitative estimation of actinium. W. SCHNEIDER AND T. MATITSCH. *S.B. Österr. Akad. Wiss. IIa,* **161,** *No.* 4–6, 131–50 (1952) *In German.*

The Ra/Ac*X* ratio of a sample may be obtained using nuclear emulsions from measurements of the number of 4-pronged "stars" at different times after impregnation; the method is simple and useful for occasional measurement, but is less sensitive and lengthier than ionization chamber measurements on the emanations. A. O. STANESBY

539.16.08

4976. On the radioactivity of ampelites. R. COPPENS. *C.R. Acad. Sci.* [*Paris*] **236,** 600–1 (*Feb.* 9, 1953) *In French.*

Examination of samples of ampelites, using nuclear emulsions, indicates that their radioactive content (U and Th) is greater than that of other sedimentary rocks, and even of the majority of volcanic rocks; the activity is uniformly distributed throughout the mass of the rock, and inclusions are very rare. The Th/U ratio seems to be considerably less than the usual value of 3. A. O. STANESBY

539.163

4977. Distribution figures of the active deposit on metallic plaques. G. VIEIRA. *Portugal. Phys.,* **3,** *No.* 2, 101–16 (1951) *In French.*

The plaque was held inside a hollow prism, filled with air, facing one end. This end was connected by a short narrow tube to a container of radium salt. The plaque was held at various negative potentials and its distance from the source was varied. The distribution of the deposit depended considerably on the shape of the prism; only slightly on the shape of the plaque, at short distances; and not at all on the applied voltage (150 to 2000). Results are given as auto-radiographs. F. R. HOLT

539.163

4978. Measurement of the period of B^{12} and of Li^8. P. BRETONNEAU. *C.R. Acad. Sci.* [*Paris*] **236,** 913–14 (*March* 2, 1953) *In French.*

Using the method of Abstr. 1185 (1952) the periods formed by (d, p) reactions were found to be $0{\cdot}022 \pm 0{\cdot}001$ and $0{\cdot}875 \pm 0{\cdot}02$ sec respectively.

W. J. SWIATECKI

539.163

4979. Some problems arising in nuclear spectroscopy. M. E. ROSE. *Physica,* **18,** 1302–3 (*Dec.*, 1952).

A review of problems either outstanding or being tackled in the following fields: (1) Calculation of internal conversion coefficients; (2) application of existing theory to β-decay; (3) application of the theory of angular correlation; (4) theory of radiative lifetime. W. J. SWIATECKI

539.163 : 778.34

4980. Demonstration of the natural radioactivity of rhenium by the nuclear emulsion method. B. GAUTHÉ AND J. M. BLUM. *C.R. Acad. Sci.* [*Paris*] **236,** 1255–6 (*March* 23, 1953) *In French.*

The electrons emitted were studied both by impregnation with rhenium salts, and by inserting thin capillary tubes containing sodium perrhenate in the emulsion. The maximum electron energy was ~34 keV, in reasonable agreement with earlier work.

J. HUGHES

539.163.1

4981. Accurate half life determination. L. J. DE VRIES, J. CLAY AND F. T. VERINGA. *Physica,* **18,** 1264–6 (*Dec.*, 1952).

A discussion of the errors involved in the use for this purpose of ionization chambers and counters and an account of the experiments of De Vries, *et al.* (1952). W. J. SWIATECKI

539.163.1

4982. The half-lives of several radioisotopes. E. E. LOCKETT AND R. H. THOMAS. *Nucleonics,* **11,** 14–17 (*March*, 1953).

The results of half-life measurements on Au^{198}, Bi^{210}, Co^{60}, I^{131}, In^{116}, Mg^{27}, Mn^{56}, Na^{24}, P^{32}, Tl^{204}, $Eu^{152+154}$. The sources were measured inside a hemispherical air ionization chamber with a quartz fibre electroscope. L. R. SHEPHERD

539.163.1

4983. An upper limit to the mean life of the 11·7 keV excited state of $^{56}Ba^{133}_{77}$. M. LANGEVIN. *C.R. Acad. Sci.* [*Paris*] **236,** 689–90 (*Feb.* 16, 1953) *In French.*

Delayed coincidence measurements indicate an upper limit of 2×10^{-8} sec for the mean life ($\frac{1}{2}$-life $1{\cdot}4\times10^{-8}$ sec). A. O. STANESBY

539.163.1

4984. The mass spectrometer determination of the half-life of Kr^{85}. R. K. WANLESS AND H. G. THODE. *Canad. J. Phys.*, **31,** 517–19 (*May*, 1953).

The half-life of Kr^{85} has been redetermined using the high precision mass spectrometer method. Several samples of krypton gas extracted from fission product material have been investigated over a period of seven years. The half-life of Kr^{85} has been found to be $10{\cdot}27 \pm 0{\cdot}18$ yr. A.

539.163.1

4985. Influence of the chemical state on the lifetime of a nuclear isomer, Tc^{99m}. K. T. BAINBRIDGE, M. GOLDHABER AND E. WILSON. *Phys. Rev.*, **90,** 430–9 (*May* 1, 1953).

Since a nuclear isomeric transition may take place by emission of either a γ-ray or an internal conversion electron, the total rate of decay may be expected to vary with any change in electronic environment, such as a difference in chemical state. Differences in the decay constant of the isomer Tc^{99m} (6 hr) in different states of chemical combination were measured by the double ionization chamber balance method. λ for this isomer is determined mainly by the internal conversion probability of a 2 keV transition which is followed promptly by a conveniently measurable 140 keV γ-ray. Two compounds in the +7 valence state were compared: $\lambda(KTcO_4) - \lambda(Tc_2S_7) = (27{\cdot}0 \pm 1{\cdot}0)\times10^{-4}\lambda(Tc_2S_7)$. λ for the metal electroplated on nickel and reduced in H_2 at 1000°c for 1 hr $-\lambda(Tc_2S_7) = (3{\cdot}1 \pm 1{\cdot}2)\times10^{-4}\lambda(Tc_2S_7)$. Errors are standard deviations. There is evidence for diffusion of the Tc into the nickel base and an accompanying decrease in λ(Tc) of ~2 parts in 10^4 compared to pure crystalline metal. λ of the metal was measured directly as $0{\cdot}1148 \pm 0{\cdot}0005\ hr^{-1}$, corresponding to a half-life of $6{\cdot}04 \pm 0{\cdot}03$ hr (limit of error). The methods used for internally checking the data and the operation of the apparatus are illustrated, and the statistics of the measurements are discussed. A.

539.163.1

4986. The half-life of I^{131}. H. H. SELIGER, L. CAVALLO AND S. V. CULPEPPER. *Phys. Rev.*, **90,** 443 (*May* 1, 1953).

An accurate determination of the half-life of I^{131} gives the value $8{\cdot}07_5 \pm 0{\cdot}02_2$ days. A.

539.163.2

4987. The decay scheme of RaC. A. H. WAPSTRA. *Physica,* **18,** 1247–9 (*Dec.*, 1952).

G.M. counter $\beta - \gamma$ coincidence-absorption measurements indicate that the 3·17 MeV β-transition in RaC goes to the ground state of RaC′. The whole absorption curve is well represented by a 19%, ~3 MeV component and an 81%, 1·55 MeV component. W. J. SWIATECKI

539.163.2

4988. Decay of ^{198}Au. L. SIMONS. *Physica,* **18,** 1250–2 (*Dec.*, 1952).

The Fermi plot of the 0·965 MeV β^- from $Au^{198} \rightarrow Hg^{198}$ exceeds a straight line below 0·4 MeV. Assuming that the β^- is followed by a 0·411 MeV γ in Hg^{198} the internal conversion coefficients are found to be $\alpha_K = 0{\cdot}031$, $\alpha_L = 0{\cdot}010$, $\alpha_M = 0{\cdot}003$, in agreement with an electric quadrupole transition.

W. J. SWIATECKI

539.163.2

4989. A study of the radiations emitted by $^{126}_{53}I$. N. MARTY, H. LANGEVIN AND P. HUBERT. *C.R. Acad. Sci.* [*Paris*] **236,** 1153–5 (*March* 16, 1953) *In French.*

The radiations were re-examined using a β-particle lens spectrometer and a γ-ray scintillation spectrometer; a level scheme is proposed. A. O. STANESBY

539.163.2

4990. Study of the radiation from ^{65}Zn. M. SAKAI AND P. HUBERT. *C.R. Acad. Sci.* [*Paris*] **236,** 1249–51 (*March* 23, 1953) *In French.*

Magnetic lens spectrometer measurements have given the following results: Any γ-ray between 150 and 225 keV has intensity $< 3\times10^{-4}$ per 1·11 MeV γ-ray. Internal conversion coefficient (total) of the 1·11 MeV γ-ray $= (1{\cdot}8 \pm 0{\cdot}2)\times10^{-4}$. The β^+ spectrum has allowed form, with end-point 327 ± 3 keV. Three different methods give 29 ± 5, 24 ± 4, and ~26, respectively, for the 1·11 MeV γ-ray/β^+ intensity ratio. J. J. WILKINS

539.163.2

4991. Radioactive decay of Y^{91}. F. I. BOLEY AND D. S. DUNAVAN. Letter in *Phys. Rev.*, **90,** 158 (*April* 1, 1953).

The decay was investigated using scintillation counters; it appears to be by β^--emission ($E_{max} = 1{\cdot}54 \pm 0{\cdot}05$ MeV) only, unaccompanied by γ-rays. A. O. STANESBY

539.163.2

4992. Activity assignment to titanium 51. W. R. HAMMOND, D. N. KUNDU AND M. L. POOL. Letter in *Phys. Rev.*, **90,** 157 (*April* 1, 1953).

The 6-min activity assigned to Ti^{51} was investigated through the reactions $Ca^{48}(\alpha, n)$, $Ti^{50}(n, \gamma)$, $Cr^{54}(n, \alpha)$, and $V^{51}(n, p)$ using enriched isotopes; the assignment is confirmed, and the nuclide emits β^--particles of $E_{max} = 1{\cdot}78 \pm 0{\cdot}1$ MeV and a low-energy γ-radiation, and has a $\frac{1}{2}$-life of 5·89 ± 0·2 min. A. O. STANESBY

539.163.2

4993. Evidence for a 25·5-day Sr—76-sec Rb chain. P. KRUGER AND N. SUGARMAN. Letter in *Phys. Rev.*, **90,** 158–9 (*April* 1, 1953).

A Rb daughter ($\frac{1}{2}$-life 76 sec) of 25·5-day Sr was separated from the Sr fraction of the spallation products of Ag irradiated with 450 MeV protons; this throws doubt on the assignment of the 25·5-day Sr activity to mass number 82. A. O. STANESBY

539.163.2

4994. Spectrometer measurement on the high energy positrons of sodium 22. B. T. WRIGHT. Letter in *Phys. Rev.*, **90,** 159 (*April* 1, 1953).

The ratio of the partial decay constants of the low- and high-energy spectra was measured. The spectra are given as curves; the ratio found was 1600 ± 400. This leads to a decay constant for decay to the ground state of Ne^{22} of $\geqslant 5{\cdot}3 \pm 1{\cdot}0\times10^{-12}$ sec^{-1}, and an *ft* value of about 10^{13}. This is less than expected. R. F. HOLT

539.163.2

4995. The radioactive decay of Cs^{134}, Os^{185}, Os^{191}, and Os^{193}. J. M. CORK, J. M. LEBLANC, W. H. NESTER, D. W. MARTIN AND M. K. BRICE. *Phys. Rev.*, **90,** 444–7 (*May* 1, 1953).

From sources of caesium of high specific activity produced in the pile and studied in photographic magnetic spectrometers, 19 electron conversion lines are observed. These are interpreted to show the existence of 11 γ-rays, 4 of which have not been previously reported. Certain *K*/*L* ratios are measured and the resolution of the components of the β-radiation presented. A plausible decay scheme consisting of 7 levels in the resultant barium 134 nucleus is offered. By irradiating osmium sources for various periods in the pile and obtaining successive exposures in magnetic spectrometers, it is possible to determine the energy and half-life of each electron conversion-line. Osmium 185 decays by *K*-capture with a half-life of 96 days. Four γ-rays are associated with this activity. Osmium 191 decays by a 14-hr isomeric transition followed by β-emission with 15-day half-life. Two γ-transitions in sequence follow the β-decay. Osmium 193 is a β-emitter with a 31-hr half-life. Some 18 electron conversion lines are observed which indicate the presence of 9 γ-rays, only 3 of which had been previously observed. A.

539.163.2

4996. Isomerism of In^{110} and In^{112}. E. BLEULER, J. W. BLUE, S. A. CHOWDARY, A. C. JOHNSON AND D. J. TENDAM. *Phys. Rev.*, **90,** 464–8 (*May* 1, 1953).

The decay of In^{110} and In^{112} has been investigated with the aid of β-ray spectrometer and coincidence measurements. From the half-life 20·7 ± 0·3 min and the $K/(L + M)$ ratio 3·7 ± 0·4, the 155 ± 1 keV isomeric transition in In^{112} is identified as *M*3. The 14·5 ± 1-min ground state emits an allowed negatron spectrum of 656 ± 6 keV and an allowed positron spectrum of 1·52 ± 0·05 MeV. Even parity and spins of 4 and 1 are assigned to the two states. The 66-min ground state of In^{110} decays by emission of an allowed positron spectrum of 2·25 ± 0·02 MeV to the 657 keV level of Cd^{110}. The electron capture from the 4·9 ± 0·2 — hr isomeric state is followed by the known 884, 937 and 657 keV γ-rays in Cd^{110}. Even parity is assigned to both levels. Conversion lines, with $K/(L + M) = 4{\cdot}5 \pm 1$ indicate an additional γ-ray of 121 keV which may be the isomeric transition having a branching ratio of about 0·6%. It would have to be an *M*3 transition with an abnormally long (factor 10^3) half-life. The existence of the In^{110} isomer is shown to remove several difficulties in the interpretation of the excitation curves of the α-particle reactions with silver. A.

539.163.2

4997. Synchrocyclotron production and properties of magnesium 28. J. W. JONES AND T. P. KOHMAN. Letter in *Phys. Rev.*, **90,** 495 (*May* 1, 1953).

Mg^{28} was produced by the reaction $Si^{30}(p, 3p)Mg^{28}$. A half-life of 22·1 ± 0·3 hours and a maximum β-energy of 0·3 MeV were determined. Several γ-rays, with energies extending to at least 2·6 MeV, were detected. J. J. WILKINS

539.163.2

4998. The gamma-ray cascade following decay of Sc^{46}. C. E. WHITTLE AND P. T. PORTER. Letter in *Phys. Rev.*, **90,** 498 (*May* 1, 1953).

Delayed coincidence measurements gave no evidence for a state in Ti^{46} with lifetime $> 1{\cdot}5\times10^{-9}$ sec. J. J. WILKINS

539.163.2

4999. Radiations from selenium^{75}. E. N. JENSEN, L. J. LASLETT, D. S. MARTIN, JR, F. J. HUGHES AND W. W. PRATT. *Phys. Rev.*, **90,** 557–63 (*May* 15, 1953).

The radiations from 125-day Se^{75} have been

examined by means of a thin-lens spectrometer and absorption-coincidence techniques. Se^{75} was found to decay to As^{75} by orbital electron capture. The energies of ten transitions ($0{\cdot}066_6$, $0{\cdot}076_6$, $0{\cdot}098_3$, $0{\cdot}124_1$, $0{\cdot}138_4$, $0{\cdot}203_2$, $0{\cdot}268_8$, $0{\cdot}281_4$, $0{\cdot}307_8$ and $0{\cdot}405_0$ MeV) were observed in the photoelectron and internal conversion spectra determined with the spectrometer. A decay scheme is proposed on the basis of the absorption-coincidence and spectrometer data. The multipole order of the 98·3 keV transition is discussed. A.

539.163.2

5000. Nuclear levels associated with zirconium 95 and niobium 95. J. M. Cork, J. M. LeBlanc, D. W. Martin, W. H. Nester and M. K. Brice. *Phys. Rev.*, **90**, 579–80 (*May* 15, 1953).

Using sources of Zr^{95}, both as a fission product and as derived from neutron capture in enriched Zr^{94}, in magnetic spectrometers, a study has been made of the β- and γ-energies and of the half-lives associated with the radioactive decay. Zr^{95} emits 3 β-rays of energy about 910, 405 and 360 keV, each followed by a γ-transition leading to a radioactive daughter product, Nb^{95}. The γ-energies are 758, 725 and 235·2 keV. The Nb^{95} decays by β-emission, of energy 165 keV, to Mo^{95} with accompanying γ-energies of 753 and 768 keV. The observed transitions are found to fit a level scheme that is not incompatible with shell theory. A.

539.163.2

5001. Inner bremsstrahlung associated with *K* capture in A^{37}. C. E. Anderson, G. W. Wheeler and W. W. Watson. *Phys. Rev.*, **90**, 606–8 (*May* 15, 1953).

An investigation has been made of the inner bremsstrahlung accompanying *K*-capture in A^{37}. The inner bremsstrahlung energy distribution was examined by absorption and scintillation spectrometer techniques and found to agree with that predicted by theory. A Kurie-type plot showed the maximum energy of the γ-radiation to be 815 ± 15 keV. A.

539.163.2

5002. Comparison of the values of the disintegration constant of Be^7 in Be, BeO, and BeF_2. J. J. Kraushaar, E. D. Wilson and K. T. Bainbridge. *Phys. Rev.*, **90**, 610–14 (*May* 15, 1953).

The difference in the decay constants of Be^7 in Be, BeO and BeF_2, have been measured using the differential ionization chamber technique. The results are $\lambda(Be) - \lambda(BeF_2) = (7{\cdot}41 \pm 0{\cdot}47)\times10^{-4}\lambda$, $\lambda(BeO) - \lambda(BeF_2) = (6{\cdot}09 \pm 0{\cdot}55)\times10^{-4}\lambda$, $\lambda(Be) - \lambda(BeO) = (1{\cdot}31 \pm 0{\cdot}51)\times10^{-4}\lambda$. These values are smaller than the results previously obtained by Leininger, Segrè and Wiegand for the same compounds, but support their earlier work. A.

539.163.2

5003. Gallium 67. B. H. Ketelle, A. R. Brosi and F. M. Porter. *Phys. Rev.*, **90**, 567–73 (*May* 15, 1953).

The electron capture decay of 78-hr Ga^{67} has been investigated with a magnetic lens spectrometer, a proportional counter spectrometer, scintillation spectrometers, and combinations of these spectrometers in coincidence. The experimental data indicate that electron capture occurs to 92 keV, 182 keV, 388 keV and 880 keV levels in Zn^{67}. The lowest level at 92 keV is a metastable one with a half-life of 8·5 μsec. Branching ratios and conversion coefficients have been determined from which consistent spin and parity assignments have been made to the Zn^{67} levels. A.

539.163.2 : 539.165

5004. The decay of gallium 65. A. H. W. Aten, Jr, H. de Wijs and M. Boelhouwer. *Physica*, **18**, 1032–3 (*Dec.*, 1952).

Measurements on the Ga^{65} fraction isolated from Zn after deuteron irradiation indicated the emission of positrons of $E_{max} = 2{\cdot}2 \pm 0{\cdot}2$ MeV, with at most a few per cent of β^--particles; it was also shown that fewer Ga^{65} nuclei decay by capture than by β^+-emission. A. O. STANESBY

539.163.2 : 539.172.4

5005. Half-life of Pd^{109} and neutron activation cross section of Pd^{102}. W. W. Meinke. *Phys. Rev.*, **90**, 410–12 (*May* 1, 1953).

The half-life of Pd^{109} has been determined to be $13{\cdot}6 \pm 0{\cdot}1$ hr by careful decay measurement on a chemically purified fraction of metallic palladium irradiated in a nuclear reactor. From the same irradiation the activation cross-section of Pd^{102} was found to be 4·8 barns for pile neutrons. This cross-section value is based on the literature value (corrected for the new half-life determination) of 11·7 barns reported for the thermal neutron activation cross-section of Pd.[108] A.

539.164

5006. Further experiments on the astatine isotope 218. F. Hiessberger and B. Karlik. *S.B. Österr. Akad, Wiss. IIa*, **161**, *No.* 1–3, 51–64 (1952) *In German.*

A broadening of the α-particle spectrum of At^{218}, observed by Karlik and Bernert [Abstr. 1900 (1948)], see also Walen, [Abstr. 5624 (1949)] and attributed by them to a complex α-particle group, was shown to be due to non-uniform absorption of At^{218} on the walls of the capillary containing the radon. A corrected value for the β/α branching ratio in Ra*A* is $2{\cdot}2\times10^{-4}$; the ½-life of At^{218} is ~2 sec.

A. O. STANESBY

539.164

5007. Correction to be applied to the theoretical energy-period relation for α-emission due to the presence of the electron cloud. P. Benoist-Gueutal. *C.R. Acad. Sci.* [*Paris*] **236**, 691–2 (*Feb.* 16, 1953) *In French.*

The influence of the electron cloud can be taken into account approximately if in the usual expression for the decay probability $\lambda(E)$, the energy $E' = E_\alpha + E_R + 65{\cdot}3(Z+2)^{7/3}$ eV, is used, E_α and E_R being the kinetic energies of the α-particle and the recoil atom respectively, and Z the atomic number of the final nucleus. J. HUGHES

539.164

5008. On the energies of the α-radiation of radium and of some of the radioelements of the Ra and RaTh families. G. Bastin-Scoffier and J. Sant'ana-Dionisio. *C.R. Acad. Sci.* [*Paris*] **236**, 1016–18 (*March* 9, 1953) *In French.*

The measurements were made in a large permanent-

magnet spectrograph, using thin weak sources and recording with nuclear emulsions; values obtained for the energies of the α-particle groups were: Ra, 4·777; Rn, 5·482; RaA, 5·996; ThX, 5·679 and Tn, 6·278 MeV, relative to Po, 5·299 MeV, as standard. A. O. STANESBY

539.164

5009. Energy per ion pair for 5-MeV alpha-particles [from Pu^{239}] in helium. T. E. BORTNER AND G. S. HURST. Letter in *Phys. Rev.*, **90**, 160 (*April* 1, 1953).

Ionization chamber measurements on N, A, H and ethylene gases confirm previous results, but with He the energies increase with purity, the best value ($46·0 \pm 0·4$ eV) being considerably higher than older estimates. W. J. SWIATECKI

539.164

5010. On the quantitative theory of radioactive α-emission. J. HERRMANN AND T. SEXL. *Acta phys. Austriaca*, **6**, *No.* 4, 288–305 (1953) *In German.*

This is developed for the case of non-vanishing azimuthal quantum number, using the exact complex eigenvalue. The solution of the Laplace differential equation is obtained in the integral form, and the asymptotic value obtained by the saddle point method. The formula for the decay constant obtained is found to involve the azimuthal quantum number explicitly only in the exponential factor. J. HUGHES

539.164 : 539.166

5011. Influence of the nuclear quadrupole moment on the α–γ angular correlation in radiothorium. A. ABRAGAM AND R. V. POUND. Letter in *Phys. Rev.*, **89**, 1306 (*March* 15, 1953).

It is shown that quadrupole coupling may provide an explanation for the discrepancy between experimental and theoretical values of the α–γ correlation in radiothorium: the interaction of the quadrupole moment in the intermediate state with the gradient of the electric field at the nucleus weakens the correlation. L. PINCHERLE

539.164.92 : 537.561

Energy per ion pair of gases and gas mixtures for α-particles. *See Abstr.* 4885

539.165

5012. The β-decay nucleon-lepton interaction according to experiment. R. NATAF. *Physica*, **18**, 1013–16 (*Dec.*, 1952) *In French.*

By comparison of the experimental data with the matrix elements estimated for β-decay between mirror nuclei (one-particle model), between nuclei of supermultiplet $(\frac{1}{2}, \frac{1}{2}, \pm\frac{1}{2})$, and between light even-mass nuclei, it is shown that the proportion of Fermi coupling (S or V) in the β-decay interaction is $\simeq$20%. R. H. DALITZ

539.165

5013. The Sargent diagram for *K*-electron capture. N. FEATHER. *Physica*, **18**, 1023–5 (*Dec.*, 1952).

A Sargent diagram ($\log_{10}$ disintegration const. in $\sec^{-1}$ v. $\log_{10}$ neutrino energy for K-electron capture in MeV) is tentatively put forward for 12 nuclides for which trustworthy data are available; the points lie fairly well on 2 straight lines of slope 2 (allowed transitions) and 3 (forbidden transitions with probable spin changes of 2 units). A. O. STANESBY

539.165

5014. A search for the double beta decay of tin 124 and zirconium 96. H. W. FULBRIGHT. *Physica*, **18**, 1026–31 (*Dec.*, 1952).

In a neutrinoless double β-decay, the total energy of the 2 β-particles is constant; this line was sought in Sn^{124} and Zr^{96}. The corresponding $\frac{1}{2}$-lives for the double β-decay are $> 1·5\times10^{17}$ and $6·2 \pm 2\times10^{16}$ yr resp. See also Abstr. 7518 (1952). A. O. STANESBY

539.165

5015. The beta-decay of ^{20}F. D. E. ALBURGER. *Physica*, **18**, 1034–6 (*Dec.*, 1952).

The radiations of F^{20} were examined using a lens spectrometer; the upper energy limit of the β-spectrum is $5·406 \pm 0·017$ MeV, and a γ-ray of $1·631 \pm 0·006$ MeV is emitted. The total disintegration energy of F^{20} is then $7·038 \pm 0·018$ MeV, giving the mass of Ne^{20} as $19·998794 \pm 26$ mass units. A. O. STANESBY

539.165

5016. *K*-capture — β⁺-emission branching ratio. R. BOUCHEZ. *Physica*, **18**, 1171–91 (*Dec.*, 1952) *In French.*

A discussion and comparison with theory of recent exptl. results on Na^{22}, V^{48}, Ni^{57}, Co^{58}, Cu^{61}, Cu^{64}, Zn^{65}, Cd^{107} and Sn^{111}. A. O. STANESBY

539.165

5017. On some effects of the atomic electrons in β- and electron-capture disintegrations. P. BENOIST-GUEUTAL. *Physica*, **18**, 1192–1200 (*Dec.*, 1952) *In French.*

A brief review of the variation of the decay constant of an electron-capturing nuclide with chemical composition; the effect of extra-nuclear electrons on the max. energy and spectral shape of β^+-emitters; auto-excitation and -ionization produced during the reorganization of the atomic electrons; and of the effect of the change in nuclear charge on the rest of the electrons during electron capture. A. O. STANESBY

539.165

5018. On the K/β^+ branching ratio of Zn^{65}. T. YUASA. *Physica*, **18**, 1267–71 (*Dec.*, 1952) *In French.*

The intensities of the Auger electrons and X-rays and of the positrons emitted by Zn^{65} were measured in a semi-circular focusing spectrometer; the overall ratio K/β^+ obtained is 41 ± 5. The shape of the β^+-spectrum is not that of a single allowed transition. A. O. STANESBY

539.165

5019. Double beta decay of Te^{130} and Se^{82}. H. D. SHARMA. Letter in *Curr. Sci.*, **22**, 45–6 (*Feb.*, 1953).

The 2-step β-decay of $Te^{130} \xrightarrow{\beta-} I^{130} \xrightarrow{\beta-} Xe^{130}$ was investigated by adding traces of I to Te and precipitating as AgI; no activity could be detected in the AgI sample. The $\frac{1}{2}$-life of Te^{130} is estimated as $> 10^{17}$ yr, or else it decays by simultaneous emission of 2 β-particles. A similar negative result was obtained for Se^{82}. A. O. STANESBY

539.165

5020. Demonstration of the emission of electrons from the outer rings of an atom, simultaneously with β-emission. F. SUZOR AND G. CHARPAK. *C.R. Acad. Sci.* [*Paris*] **236,** 481–2 (*Feb.* 2, 1953) *In French.*

It was shown that about 1% of the β-emissions from P^{32} and Cl^{36} are accompanied by the emission of an electron from the outer rings; in the case of RaE the percentage was less (about $\frac{1}{2}$). The energy of these electrons was about 35 keV. The percentages are about what would be expected from theory. See also Abstr. 6557 (1952). P. M. DAVIDSON

539.165

5021. A study of the genuine coincidences observed during the disintegration of P^{32}. M. DUQUESNE. *C.R. Acad. Sci.* [*Paris*] **236,** 598–600 (*Feb.* 9, 1953) *In French.*

A small number of true coincidences was obtained using two counters in an exptl. arrangement which took account of coincidences due to back-scattering of the electrons; the number is a function of the angle between the axes of the counters. The effect was also found with S^{35} and RaE. A. O. STANESBY

539.165

5022. The beta-spectrum of Mg^{28}. L. MARQUEZ. Letter in *Phys. Rev.*, **90,** 330 (*April* 15, 1953).

Spectra of allowed shape have been obtained for both Mg^{28} and Al^{28}, with end points 418 ± 10 keV and 2850 ± 50 keV respectively. The Mg^{28} half-life is $20{\cdot}8 \pm 0{\cdot}5$ hr, with $\log ft = 4{\cdot}25$. J. J. WILKINS

539.165

5023. The effect of the finite de Broglie wavelength in the theory of beta-decay. M. E. ROSE AND C. L. PERRY. *Phys. Rev.*, **90,** 479–82 (*May* 1, 1953).

An accurate numerical evaluation of the Z and energy dependent parts of the correction factors for allowed and forbidden β-transitions has been carried out. The range of parameters considered is: 88 values of Z (from 10 to 96 inclusive in steps of 2 and for positrons ($Z < 0$) as well as electrons ($Z > 0$)); 33 values of p, the electron momentum, in mc units ($0{\cdot}1 \leqslant p \leqslant 25$) for $|Z|$ through 24 and 31 values of p ($0{\cdot}1 \leqslant p \leqslant 15$) for $|Z| > 24$; four values of j (the electron momentum ($\frac{1}{2} \leqslant j \leqslant 7/2$). For each value of Z, p and j the six wave-function combinations (L_ν, M_ν, N_ν, P_ν, Q_ν, R_ν) needed for the general mixed β-interaction are obtained. For the given range of j, analysis of β-spectra can be carried out through third forbidden transitions. The results given here show that the theoretically allowed spectra should be modified by an energy-dependent factor. For not-too-low maximum energies, this modification in the shape of the allowed β-spectrum may be observable with presently attainable precision. A.

539.165 : 539.166

5024. Critical survey of techniques of beta- and gamma-spectroscopy. M. DEUTSCH. *Physica,* **12,** 1037–42 (*Dec.*, 1952).

A very brief review of the techniques of measurement of β- and γ-ray energies and the use of coincidence methods to establish decay schemes.

L. R. SHEPHERD

539.165 : 539.166

5025. On the theory of the directional distribution and the polarization of beta and gamma rays emitted by orientated nuclei. H. A. TOLHOEK. *Physica,* **18,** 1257–61 (*Dec.*, 1952).

An account of calculations of Tolhoek and Cox [see Abstr. 7527 (1952)] using Racah's algebra to find the correlations between successive radiations. A survey of possible applications is given.

W. J. SWIATECKI

539.165.08

5026. High resolution and high precision beta-spectrometry. R. E. SIDAY. *Physica,* **18,** 1063–5 (*Dec.*, 1952).

The optimum conditions for obtaining high intensity without loss of resolving power, are discussed. Some techniques, which are being employed to obtain a high precision in absolute determinations of conversion line energies, are outlined briefly. L. R. SHEPHERD

539.165.08

5027. Measurement of beta particles of low energy and allied phenomena. S. C. CURRAN. *Physica,* **18,** 1161–70 (*Dec.*, 1952).

The use of proportional counter β-spectrometers is discussed. Results obtained are reviewed, and a bibliography is given. F. R. HOLT

539.166

5028. An investigation of the RaC gamma-rays from their Compton secondaries. M. MLADJENOVIĆ AND A. HEDGRAN. *Physica,* **18,** 1242–6 (*Dec.*, 1952).

Using a double-focusing spectrometer, two new γ-rays (697 and 1728 keV) were found, and all but one (1290 keV) of those previously reported by other workers were confirmed. The results are correlated with the known internal conversion spectrum.

J. J. WILKINS

539.166

5029. On the γ-radiation of $^{80}_{35}Br$ (18 min). J. LABERRIGUE-FROLOW, R. BERNAS AND H. LANGEVIN. *C.R. Acad. Sci.* [*Paris*] **236,** 1246–8 (*March* 23, 1953) *In French.*

Scintillation spectrometer observations on an enriched source are reported. Only ~500 keV radiation was found, attributable entirely to annihilation of the $2{\cdot}8\%$ β^+ branch. Any higher-energy γ-ray has intensity $<0{\cdot}035$ per β^-. J. J. WILKINS

539.166

5030. The angular correlation of the cascade gamma-rays from the decay of Au^{198}. C. D. SCHRADER, E. B. NELSON AND J. A. JACOBS. Letter in *Phys. Rev.*, **90,** 159 (*April* 1, 1953).

These experiments determine the spin and parity of the 1·09 MeV level of Hg^{198} as 2^+, and the 0·68 MeV γ-radiation as 0·60 quadrupole, 0·40 dipole radiation.

A. O. STANESBY

539.166

5031. On the theory of angular correlation of two successive gamma quanta emitted by orientated nuclei. J. A. M. COX. *Physica,* **18,** 1262–3 (*Dec.*, 1952).

The general formula for the correlation of 2 quanta along k_1 and k_2 emitted by nuclei along η, and an account of some special cases treated in Abstr. 7527–8 (1952). W. J. SWIATECKI

539.166

5032. Effect of the electric quadrupole interaction on the gamma-gamma directional correlation in Cd^{111}. H. Albers-Schönberg, F. Hänni, E. Heer, T. B. Novey and P. Scherrer. Letter in *Phys. Rev.*, **90**, 322 (*April* 15, 1953).

Disturbance of the correlation by extra-nuclear fields has been studied experimentally. Magnetic fields up to 20 000 gauss had little effect. Using metallic indium single crystals as sources, however, marked dependence of anisotropy on crystal orientation was observed. Electric quadrupole interaction with the crystalline field is inferred. J. J. WILKINS

539.166 : 539.152

5033. The polarization of γ-radiation from aligned nuclei. N. R. Steenberg. *Proc. Phys. Soc.* [*London*] *A*, **66**, 381–402 (*April*, 1953).

Formulae are derived giving the degree of polarization and its angular dependence of γ-radiation anisotropically emitted from nuclei aligned at low temperatures. These are in the form of Legendre series limited by the multipole order or nuclear spin. It is shown how the polarization determines the character of the radiation and the sign of the magnetic moment of the oriented nucleus. A.

539.166 : 539.152

5034. Population distribution of nuclei aligned at low temperatures. N. R. Steenberg. *Proc. Phys. Soc.* [*London*] *A*, **66**, 399–402 (*April*, 1953).

Population distribution functions are given for four suggested methods of nuclear alignment at low temperatures. They are given for arbitrary temperature and in approximate form valid at high temperatures. It is shown how the approximation is related to the approximate angular distribution of γ-radiation. A.

539.166 : 539.172.4

5035. The spectrum of the γ-radiation emitted in the reaction $n + p \rightarrow d + \gamma$. A. Bracci, U. Facchini and A. Malvicini. Letter in *Phys. Rev.*, **90**, 162 (*April* 1, 1953).

The slow neutron capture γ-rays have been studied with NaI and anthracene crystals. The results show that no line $>20\%$ of the 2·23 MeV line exists in the range 0·7–2·23 MeV. J. J. WILKINS

539.166.08

5036. Energy calibration of instruments. K. Siegbahn. *Physica*, **18**, 1043–62 (*Dec.*, 1952).

The use of beta-ray spectrometers for absolute determination of energies of gamma-rays and conversion lines to a high degree of precision (up to $\sim$1 in 10^4), is reviewed. Some of the high resolution spectrometers used at Stockholm are described briefly and the results of absolute measurements, including the energies of: annihilation radiation; the Au^{198} γ-radiation; Cs^{137} γ-rays and the ThB *F*, *I*, *L* and *X* lines are given. A broadening by 80 eV of all *K* conversion lines in the ThB spectrum, explained on the basis of *K*-shell level width, has been observed. Annihilation radiation in Cu has been found to broaden by 975 eV, due to Doppler effect. A projected ironless double-focusing spectrometer is described. L. R. SHEPHERD

539.166.08

5037. Quantitative evaluation of γ-ray spectra from scintillation measurements. D. Maeder and V. Wintersteiger. *Physica*, **18**, 1147–50 (*Dec.*, 1952).

Equations and calculated curves are presented, showing the pulse distributions to be expected from Compton and photo-effects. Assuming γ-ray energies between 200 and 1200 keV, and NaI crystals of various sizes, corrections are given for absorption of secondary quanta, for finite γ-ray beam cross-sections and for back-scattering in the light pipe. J. J. WILKINS

539.166.08

5038. Comparison of gamma-ray reflections from the (550) and (310) planes of quartz. H. C. Hoyt, J. J. Murray and J. W. M. DuMond. Letter in *Phys. Rev.*, **90**, 169 (*April* 1, 1953).

It is proposed to increase the range and accuracy of the curved crystal spectrometer by using the (550) planes. Reflections 1/15·6 as intense as (310) reflections have been observed. J. J. WILKINS

539.166.08

5039. The measurement of energies and intensities of γ-rays with a pair spectrometer. B. B. Kinsey and G. A. Bartholomew. *Canad. J. Phys.*, **31**, 537–76 (*May*, 1953).

The performance of a pair spectrometer of the Walker and McDaniel type is discussed from both a theoretical and an experimental point of view. It is shown that the energy of the γ-ray may be measured to a first approximation by the product of the distance between the inner edges of the slits which define the coincidence counters and the highest value of the magnetic field at which coincidences are found. A more accurate value of the energy of the γ-ray may be obtained by adding a small correction, called the "toe" correction, to the result so obtained. The magnitude of this correction is dependent on the γ-ray energy and on the width of the slits and is obtained from calculations of the shape of the coincidence peak based on the Bethe–Heitler formula. The correction depends very little on the length of the slits or on the thickness of the radiator. The relation between the calculated correction and the slit width has been examined experimentally. It is shown that the ultimate accuracy in energy measurement depends on the homogeneity of the magnetic field and on the error involved in the calculated toe correction. The latter error can be minimized by using very narrow slits and may be eliminated by plotting the value of magnetic field at the upper limit of the coincidence spectrum against the slit width and extrapolating the curve so obtained to zero slit width. The uncertainty in the magnetic field of the present instrument introduces a possible systematic error of about 0·05%. Measured values of the energies of a number of neutron capture γ-rays are compared with the values derived from the energy balance in (d, p) reactions. The results are in good agreement (within 0·1%). The relative counting efficiency as a function of energy is calculated theoretically and found to be in good agreement with experiment from 2·75 to 7·4 MeV. Above 7·4 MeV no good method of checking the theoretical efficiency has been found. The absolute value of the counting efficiency at 2·75 and 7·38 MeV has been measured

y an ionization chamber method and is found to be n rough agreement with theoretical estimates. A.

539.166.2

5040. On the paper by V. E. Golant "Vibration otation spectra of atomic nuclei." S. G. RYZHANOV. Letter in *Zh. eksper. teor. Fiz.*, **23**, *No.* 1 (7) 128–9 (1952) *In Russian.*

Golant's [Abstr. 5290 (1952)] scheme cannot accommodate the dipole γ-lines of RaC′ and ThC′, or the scheme cannot give the intensity relation between dipole and quadrupole lines, independent of the correct vibration-rotation matrix elements.

J. JACOBS

539.166.75

5041. Absorption coefficients of gamma-rays with energies between 0·3 and 1·5 MeV. S. J. WYARD. *Proc. Phys. Soc.* [*London*] *A*, **66**, 382–90 (*April*, 1953).

Accurate measurements have been made of the absorption coefficients of γ-rays covering the range of quantum energy from 0·3 to 1·5 MeV and of atomic number from 6 to 92. The results verify the Klein–Nishina formula over the whole range of quantum energy. They confirm the calculations of Hulme and co-workers for the photoelectric coefficient at 0·3 MeV, but disagree with them at higher energies. Some improvements have been made in the method of measuring absorption coefficients, and certain errors, previously overlooked, have been noted and corrected. A.

539.166.75

5042. Measurement of nuclear gamma-ray absorption in carbon. R. N. H. HASLAM, R. J. HORSLEY, H. E. JOHNS AND L. B. ROBINSON. *Canad. J. Phys.*, **31**, 636–56 (*May*, 1953).

The cross-section for the absorption of γ-rays by carbon has been determined as a function of photon energy by means of "nuclear detectors." The electronic absorption coefficients in the energy range 12 to 20 MeV are found to be about 1% lower than the theoretical values. The nuclear absorption is shown to exhibit a resonance behaviour. The integrated cross-section in carbon is considerably lower than predicted. The contribution of nuclear scattering is found to be negligible. Differences in results as determined by three different detecting reactions, $C^{12}(\gamma, n)C^{11}$, $O^{16}(\gamma, n)O^{15}$ and $S^{32}(\gamma, d)P^{30}$, are discussed on the basis of detector sensitivity. It is suggested that the absorption mechanism can be represented by a continuous absorption on which is superimposed absorption peaks. A.

539.166 75 : 539.185.7

5043. Absorption in earth of γ-rays and neutrons. G. GUÉBEN. *Bull. Soc. Roy. Sci. Liège*, **22**, 11–23 (*Jan.*, 1953) *In French.*

Various kinds of earth are analysed chemically, and their efficacy as absorbers of γ-rays and of neutrons is carefully measured experimentally. Tables and curves are given comparing the absorption in different thicknesses and weights of these materials, with that in Pb. D. V. MABBS

539.166.83

5044. Auger lines in the beta-spectra of UX and As. P. H. STOKER AND ONG PING HOK. *Physica*, **18**, 1253–6 (*Dec.*, 1952).

539.166.83

5045. Auger transitions in silver. F. A. JOHNSON AND J. S. FOSTER. *Canad. J. Phys.*, **31**, 469–71 (*May*, 1953).

Twenty of the K Auger lines of silver have been resolved and estimates of their relative intensities obtained. Comparison with the theoretical intensities calculated by Burhop indicates that the existing theory is not quantitatively correct and that relativistic modifications offer little hope of improvement. Special attention is directed to the $K \rightarrow LL$ lines where disagreement with theory is most marked. Comparison with similar observations previously reported for gold and bismuth shows an interesting agreement in the observed ratio of the intensity of the $K \rightarrow L_{II}L_{III}$ line to that of the $K \rightarrow L_{III}L_{III}$ line, and in the ratio of the intensity of the $K \rightarrow L_IL_{III}$ line to that of the $K \rightarrow L_IL_I$ line. A.

539.166.835

5046. Dependence of pair production cross-section on nuclear charge number for gamma-rays of Th(C + C′), RaC and Co^{60}. B. HAHN, E. BALDINGER AND P. HUBER. *Helv. phys. Acta*, **25**, *No.* 5, 505–20 (1952) *In German.*

The Z-dependence of the pair-creation cross-section has been measured. Positive deviations from the theory of Bethe and Heitler (Born's approximation) are found, which increase with decreasing energy of the γ-rays and increasing atomic number. The results are in good agreement with more exact calculations of Jaeger and Hulme. A.

539.166.835

5047. Internal pairs in anisotropic emission. G. GOLDRING. *Proc. Phys. Soc.* [*London*] *A*, **66**, 341–5 (*April*, 1953).

The angular correlation of internally converted pairs is investigated for cases in which the γ-rays are emitted anisotropically. Interference between electric and magnetic multipoles is considered. A.

539.166.835

5048. Compton electron suppression in the gamma-ray spectra of Ra(B + C), Co^{60}, and Ta^{182}. R. M. PEARCE AND K. C. MANN. *Canad. J. Phys.*, **31**, 592–63 (*May*, 1953).

A method of suppression of the Compton electron background present in photoelectron spectra is described. The method employs an anticoincidence element which eliminates Compton electron pulses in the spectrometer detector counter and leaves photoelectron pulses unaffected. The technique has been applied to the photoelectron spectra of Co^{60}, Ta^{182} and Ra(B + C). Evidence is presented for a previously unreported 1·01 MeV γ-ray transition in Ta^{182}. The spectrum of Ra (B + C) is compared with the spectra reported by Ellis and by Latyshev. Some of the new transitions found by Latyshev are confirmed. Other γ-rays not reported by other workers are presented here. A.

539.166.835

5049. Time distribution of positron annihilation in liquids and solids. R. E. BELL AND R. L. GRAHAM. *Phys. Rev.*, **90**, 644–54 (*May* 15, 1953).

The time distribution of the annihilation radiation

emerging from liquids and solids, following the absorption by the samples of fast positrons, has been studied by the delayed coincidence method. The mean life of positrons in metals is found to be about $1{\cdot}5\times10^{-10}$ sec, nearly independent of the metal chosen. Some simple crystals behave similarly, but many amorphous substances, both solid and liquid, show a complex time decay in which about $\frac{2}{3}$ of the positrons annihilate with mean life a few times 10^{-10} sec, and the remaining $\frac{1}{3}$ with mean life from $0{\cdot}45\times10^{-9}$ sec to $3{\cdot}5\times10^{-9}$ sec, depending on the substance. This longer lifetime is shown to decrease, in general, as the sample is cooled. Placing the sample in moderate electric and magnetic fields has no detectable effect. The long-delayed radiation is shown to be similar in energy and angular distribution to the more prompt component. Tentative interpretations of these facts are given, but some points still await a full explanation. A.

539.169

5050. Preparation of tagged spherical clay particles. W. S. Ginell and G. P. Simon. *Nucleonics*, **11**, 49–51 (*March*, 1953).

Small spheres, 0·5 to 20 microns in diameter, of montmorillonite clay, are made by passing the clay, suspended in a stream of oxygen, through a gas flame at a maximum temperature of about 1100°c where the clay particles fuse into a spherical shape. The particles cool sufficient rapidly, on leaving the flame, to retain their form. The clay may be activated before treatment by ion exchange with radioactive elements. A table of chemically suitable elements is given. After heat treatment the particles are extremely inert to loss of activity by leaching.

L. R. SHEPHERD

539.169

5051. Radioactive isotopes: An introduction to their preparation, measurement and use. W. J. Whitehouse and J. L. Putman. *Oxford: The Clarendon Press* (1953) 440 *pp.*

"This book is intended for those who are making practical use of radioactive isotopes. The authors have been associated with the production, measurement and use of isotopes at Harwell, and they present a concise account of the physical background necessary to appreciate the potentialities of the new techniques."

539.169

5052. A course of radioactive determinations. R. H. McFarland and R. E. Hein. *Amer. J. Phys.*, **21**, 325–30 (*May*, 1953).

A lecture-laboratory course in the use of radioactive isotopes is discussed. The scope of the material presented should furnish adequate initial training for persons whose future may be expected to include work with radioactive materials. A.

539.169 : 541.127

Application of radioactive indicators to investigations on powder reactions in systems of silicates. *See Abstr.* 5158

539.169 : 615

5053. Application of the radioactive and stable isotopes in pharmacological research. M. Frimmer. *Angew. Chem.*, **64**, *No.* 23, 638–42 (1952) *In German.*

Describes the use of C^{14} in pharmacological investigations on urethane, tumour-active substances (nitrogen-mustard), adrenaline, barbiturates, anaesthetics, antihistaminics, dicoumarol, mescalin, blood substitutes, alkaloids and glycosides; of S^{35} in studies of penicillin and sulphonamides, I^{131} on the metabolism of the thyroid gland. Various isotopes can be used as indicators in research on vitamins and hormones, and on the role played by mineral constituents, metals and halogens in human body, as well as in toxicological research. Seventy-five references are given.

F. LACHMAN

NUCLEAR REACTIONS 539.17

539.172

5054. Higher spin polarizations in nuclear reactions. A. Simon. Letter in *Phys. Rev.*, **90**, 325 (*April* 15, 1953).

A general expression is written down for the expectation value of any irreducible spin tensor for particles outgoing from a nuclear reaction in a particular direction. R. H. DALITZ

539.172

5055. On the occurrence of high energy heavy fragments in the splitting of nuclei by cosmic rays. V. I. Veksler. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 6, 865 (1952) *In Russian.*

The simultaneous interactions associated with meson exchanges between an incident nucleon and several nuclear particles might be responsible for the ejection of heavy fragments. W. J. SWIATECKI

539.172.11

5056. The (α, n) and $(\alpha, 2n)$ cross sections of Ag^{109}. E. Bleuler, A. K. Stebbins and D. J. Tendam. *Phys. Rev.*, **90**, 460–4 (*May* 1, 1953).

The excitation curves for the reactions $Ag^{109}(\alpha, n)In^{112}$ and $Ag^{109}(\alpha, 2n)In^{111}$ have been measured for α-energies up to 19·5 MeV. The threshold for the $(\alpha, 2n)$ reaction is $14{\cdot}8 \pm 0{\cdot}2$ MeV. The sum of the cross-sections agrees approximately with the total cross-section calculated for a radius $R \sim 1{\cdot}6\times10^{-13}A^{\frac{1}{3}}$ cm. The energy dependence of the ratio $\sigma(\alpha, 2n)/\sigma(\alpha, n)$ can be interpreted as being in agreement with either a nearly constant nuclear temperature of 1·7 MeV or with a level density $\omega(E) = \text{const.} \exp[2(aE)^{\frac{1}{2}}]$ with $a = 2{\cdot}5\ \text{MeV}^{-1}$. The corresponding temperature $\theta = (E/a)^{\frac{1}{2}}$ varies from 1·7 MeV to 2·2 MeV for excitation energies between 7·5 and 12 MeV. These apparent temperatures are considerably higher than those found by direct measurement of (p, n) and (n, n) neutron spectra. A.

539.172.11

5057. Secondary particles resulting from 375-MeV alpha-bombardment of nuclei. R. W. Deutsch. Letter in *Phys. Rev.*, **90**, 499 (*May* 1, 1953).

See Abstr. 1906 (1953). Yields of secondary particles (H^1 to C^{14}) from targets of Be, Al, Ni, Ag, Au and U have been determined. Fragments of $A > 4$ are frequently emitted with high momenta.

J. J. WILKINS

539.172.13

5058. Levels in N^{14} from the $C^{13}(p,\gamma)N^{14}$ reaction. D. Hicks, T. Husain, L. G. Sanders and L. E. Beghian. Letter in *Phys. Rev.*, **90**, 163 (*April* 1, 1953).

Gamma-radiation from the resonant proton capture of C^{13} were examined using a scintillation pair spectrometer, and lines were found at $5{\cdot}1 \pm 0{\cdot}2$ ($\sim 0{\cdot}04$), $4{\cdot}45 \pm 0{\cdot}1$ ($0{\cdot}18$), $3{\cdot}05 \pm 0{\cdot}1$ ($\sim 0{\cdot}15$), $2{\cdot}75 \pm 0{\cdot}1$ ($\sim 0{\cdot}10$) and $2{\cdot}35 \pm 0{\cdot}1$ MeV ($\sim 0{\cdot}25 \times$ intensity of $8{\cdot}06$ MeV transition). The level scheme of N^{14} is discussed. A. O. Stanesby

539.172.13

5059. On the interaction of 95-MeV protons with D, Li, Be, C, Al, Cu, and Pb nuclei. J. A. Hofmann and K. Strauch. *Phys. Rev.*, **90**, 449–60 (*May* 1, 1953).

A measurement has been made of the energy distribution of neutrons emitted from various targets at angles of 0°, 5°, 10°, 16° and 28° with respect to the primary 95 MeV proton beam. The results fall into three groups: (1) the number of neutrons emitted by C, Al, Cu and Pb targets decreases with neutron energy and with angle of emission; (2) the energy distribution of neutrons emitted from D is peaked, but the width is believed to represent mainly the energy distribution of the primary proton beam; (3) neutrons emitted from Li and Be show a peaked energy distribution, with the size of the peak decreasing rapidly with increasing angle of emission. The spectra obtained from the heavier elements appear to be in general agreement with the theory of high energy nuclear reactions based on the generation of a nuclear cascade. However, the forward minimum and the high energy peak predicted by Goldberger's calculations have not been observed with the heavier elements. The results obtained with Be are interpreted on the basis of a very simplified model. A.

539.172.13

5060. N^{14} level structure from the $C^{13}(p,n)N^{13}$ reaction. J. K. Bair, J. D. Kington and H. B. Willard. *Phys. Rev.*, **90**, 575–6 (*May* 15, 1953).

The neutron yield resulting from proton bombardment of C^{13} has been extended to a proton energy of 5 MeV. Maxima were found at bombarding energies of $3{\cdot}78$, $4{\cdot}01$, $4{\cdot}10$, $4{\cdot}18$, $4{\cdot}52$ and $4{\cdot}8$ MeV. The corresponding energies in the N^{14} compound nucleus are $11{\cdot}05$, $11{\cdot}26$, $11{\cdot}35$, $11{\cdot}44$, $11{\cdot}74$ and $12{\cdot}0$ MeV. A.

539.172.13 : 523.877

The reaction rate of the proton-proton chain. *See Abstr.* 4577

539.172.13

5061. The influence of the Coulomb field on the angular distribution of (d,n) reactions. J. Yoccoz. *C.R. Acad. Sci.* [*Paris*] **236**, 587–9 (*Feb.* 9, 1953) *In French.*

The ψ of the incident d is represented by Sommerfeld's integral expression. The resulting coefficients $g^{m_p}_{l_p}$ determining the angular distribution in the theory of Bhatia *et al.* (1952) are derived. W. J. Swiatecki

539.172.13

5062. Evidence for the excited state of He^5 in the reaction $Li^7(d,\alpha)He^5$. P. Cüer and J. J. Jung. *C.R. Acad. Sci.* [*Paris*] **236**, 1252–4 (*March* 23, 1953) *In French.*

The reaction was studied with photographic plates, at an incident deuteron energy of $0{\cdot}98$ MeV. The energy of the excited state was $\sim 2{\cdot}5 \pm 0{\cdot}2$ MeV, and its breadth $\sim 1{\cdot}5 \pm 0{\cdot}3$ MeV. No higher excited states were detected in this reaction. J. Hughes

539.172.13

5063. Energy levels in N^{14} and C^{14} from deuteron bombardment of C^{13}. R. E. Benenson. *Phys. Rev.*, **90**, 420–8 (*May* 1, 1953).

An approximately 50 keV thick carbon target enriched to 61% C^{13} was bombarded by $3{\cdot}89$ MeV deuterons. The neutrons resulting from the $C^{13}(d,n)N^{14}$ and $C^{12}(d,n)N^{13}$ reactions were detected in photographic emulsions placed at angles of 0°, 20°, 45° and 80° with respect to the incident beam. It was possible to examine the energy level scheme of N^{14} up to $8{\cdot}1$ MeV excitation and by means of Butler's stripping theory to assign parities to the first three excited states. Energy levels of N^{14} are located in this experiment at $2{\cdot}23 \pm 0{\cdot}10$, $3{\cdot}85 \pm 0{\cdot}08$, $4{\cdot}80 \pm 0{\cdot}07$, $4{\cdot}97 \pm 0{\cdot}07$, $5{\cdot}76 \pm 0{\cdot}05$, $6{\cdot}23 \pm 0{\cdot}05$, $6{\cdot}43 \pm 0{\cdot}04$, $7{\cdot}00 \pm 0{\cdot}04$, $7{\cdot}72 \pm 0{\cdot}04$ and $8{\cdot}08 \pm 0{\cdot}06$ MeV excitation with possible levels at $5{\cdot}5 \pm 0{\cdot}1$, $6{\cdot}1 \pm 0{\cdot}1$ and $7{\cdot}50 \pm 0{\cdot}04$ MeV excitation. The parities of the $2{\cdot}23$ and $3{\cdot}85$ MeV levels are found to be even with $J \leq 2$ while that of the $4{\cdot}8$ MeV level is found to be odd with $J = 0$ or 1. As an auxiliary experiment, the $C^{13}(d,p)C^{14}$ reaction was investigated at six angles of observation again by use of photographic emulsions. No levels clearly ascribable to C^{14} were observed below the known $6{\cdot}1$ MeV excited state. This state appears to have odd parity, $J = 0$ or 1. A.

539.172.13

5064. The $Zn^{64}(d,\alpha n)Cu^{61}$ reaction. C. S. Cook and F. T. Porter. *Phys. Rev.*, **90**, 429 (*May* 1, 1953).

Relative cross-sections for the $Zn^{64}(d,\alpha n)Cu^{61}$ and $Zn^{66}(d,\alpha)Cu^{64}$ reactions have been determined from β-ray data. The ratio of the cross-sections for these two reactions is $6{\cdot}3/100$. A.

539.172.13

5065. The high energy charged particles from targets bombarded by 190-MeV deuterons. L. Schecter, W. E. Crandall, G. P. Millburn, D. A. Hicks and A. V. Shelton. *Phys. Rev.*, **90**, 633–43 (*May* 15, 1953).

An investigation has been made of the angle and energy distributions of the high-energy charged particles which emerge from beryllium, carbon and uranium nuclei bombarded by 190 MeV deuterons. The results indicate that the yields can be explained as primarily due to two kinds of processes; nucleon-nucleon interactions, and stripping. Under this assumption, the total stripping cross-section has been determined to be $0{\cdot}35 \pm 0{\cdot}03$ barn for the lighter elements and $2{\cdot}6 \pm 0{\cdot}4$ barns for uranium. These values suggest an $A^{\frac{2}{3}}$ dependence for this cross-section. A.

539.172.13 : 539.163

5066. Nuclear reactions and radioactivities resulting from 6·7 MeV ^3H and 21 MeV ^3He cyclotron bombardments. M. L. Pool. *Physica*, **18**, 1304–7 (*Dec.*, 1952).

Discussion of 17 (H^3; n, p, d, $2n$ or He^3) reactions

with O, Al, Co, Cu, Ge, Rh, Ag and 16 (He^3; n, α, p, d, n or $2n$) reactions with Be, C, O, Si, Ni, Cu. W. J. SWIATECKI

539.172.3

5067. Cross sections for the photodisintegrations $^{12}C(\gamma, 3\alpha)$ and $^{16}O(\gamma, 4\alpha)$. F. K. GOWARD AND J. J. WILKINS. *Atomic Energy Res. Establ.* [*Harwell*] *Mem. G/M*127, 7 *pp.* (1952).

539.172.3

5068. Identification of $(\gamma, p\alpha)$ reactions in nuclear emulsions. M. J. BRINKWORTH, F. K. GOWARD AND J. J. WILKINS. *Atomic Energy Res. Establ.* [*Harwell*] *Mem. G/M*130, 4 *pp.* (1952).

The extent to which the reactions $^{12}C(\gamma, p\alpha)^7Li$, $^{14}N(\gamma, p\alpha)^9Be$ and $^{16}O(\gamma, p\alpha)^{11}B$ may account for certain three-pronged stars observed in nuclear emulsions is discussed. It is suggested that the first reaction accounts for at least 10 of the 97 stars considered, but evidence for the other two reactions is inconclusive. The uncertainty arises from two causes: Firstly, it is not possible to allocate a star definitely to one or other of the above three reactions; if probable errors in measurement are allowed for, allocation can be made only on a statistical basis. Secondly, since an α-particle of energy $<$ about 0·3 MeV cannot be detected in a nuclear emulsion, it is possible to confuse the reactions with the 4-particle reactions $N^{14}(\gamma, d3\alpha)$ and $N^{14}(\gamma, np3\alpha)$. A.

539.172.3

5069. Absolute determination of the $Cu^{63}(\gamma, n)$ and $C^{12}(\gamma, 3\alpha)$ cross-sections for lithium γ-rays. H. GLÄTTLI, O. SEIPPEL AND P. STOLL. *Helv. phys. Acta*, **25**, *No.* 5, 491–9 (1952) *In German.*

Gamma-rays of 17·6, 14·8 and ~12 MeV were used. High precision absolute measurements gave: $\sigma_{Cu} = 0{\cdot}048 \pm 0{\cdot}008 \times 10^{-24}$ cm^2; $\sigma_c = 1{\cdot}75 \pm 0{\cdot}25 \times 10^{-28}$ cm^2. A.

539.172.3

5070. The photodisintegration of the Li^6 nucleus into a deuteron and an α-particle. P. JENSEN AND K. GIS. *Z. Naturforsch.*, **8a**, 137–42 (*Feb.–March*, 1953) *In German.*

Using a proportional counter the cross-section for $Li^6(\gamma, d)He^4$ produced by 2·62 MeV γ's from ThC″ was found to be $< 3{\cdot}5 \times 10^{-29}$ cm^2 with a probability of 99%. Similar results of Titterton (1950) and Glenn (1952) at 2·76, 6·3 and 17·6 MeV are discussed. It is concluded that the smallness of the cross-section is not due to a general selection rule but to an accumulation of effects which can partly be traced to the properties of Li^6. W. J. SWIATECKI

539.172.3

5071. The nuclear photo-effect in beryllium at high energies. H. ÜBERALL. *Z. Naturforsch.*, **8a**, 142–8 (*Feb.–March*, 1953) *In German.*

Assuming the ground state to be a $^2P_{3/2}$ level of a square well of $r_0 = 5 \times 10^{-13}$ cm and depth 12·09 MeV the cross-sections and angular distributions were calculated in the range 20–200 MeV using the Born approximation and neglecting relativistic effects but taking account of retardation. The total cross-section is of order 10^{-28} cm^2 at 20 MeV but soon oscillates down to ~10^{-30} cm^2. The angular distribution is mainly $a \sin^2\theta + b$ with $a \gg b$. W. J. SWIATECKI

539.172.

5072. The (γ, α) reaction of B^{11} and B^{10}. [illegible] LOCHER AND P. STOLL. Letter in *Phys. Rev.*, **90**, 1[illegible] (*April* 1, 1953).

Cross-sections for transitions to the ground-stat[illegible] and excited states of Li^7 and Li^6 have been determine[illegible] using $(Li^7 + p)$ γ-rays incident on boron-loadd[illegible] nuclear emulsions. Range-energy curves for Li^7 an[illegible] Li^6 ions in emulsions are deduced. J. J. WILKI[illegible]

539.172

5073. Inelastic nuclear scattering of photons [illegible] Rh^{103}. C. SÁNCHEZ DEL RÍO Y SIERRA AND V. [illegible] TELEGDI. *Phys. Rev.*, **90**, 439–42 (*May* 1, 1953).

A lower limit to the inelastic nuclear photo[illegible] scattering cross-section of Rh^{103} was determined [illegible] function of energy. Rhodium foils were expose[illegible] to a bremsstrahlung beam and the yield [illegible] $Rh^{103}(\gamma, \gamma')Rh^{103m}$ was measured as a function [illegible] the upper limit of the spectrum. Activities wer[illegible] counted with a windowless 4π proportional counte[illegible] and $Ta^{181}(\gamma, n)Ta^{180}$ was used as a monitor abov[illegible] 8 MeV, adopting the improved results of th[illegible] Sasketchewan group. It was ascertained that the fas[illegible] neutron contamination of the beam contributed but [illegible] small fraction of Rh^{103m} activity. The cross-section[illegible] obtained from the yield curve by customary methods[illegible] is found to go through a peak of the order of 10 m[illegible] at about 13 MeV and to be appreciable below th[illegible] $Rh^{103}(\gamma, n)Rh^{102}$ threshold (9·35 MeV). The observe[illegible] location of the peak is considerably lower than woul[illegible] be expected for $Rh^{103}(\gamma, n)$ from the empirica[illegible] A-dependence of (γ, n) cross-sections, and is also a[illegible] variance with the observations of Katz and Camero[illegible] on $Au^{197}(\gamma, \gamma')Au^{197}$, but appears plausible on[illegible] theoretical grounds as does the magnitude of th[illegible] cross-section. A[illegible]

539.172...

5074. Cross-section for the photodisintegration o[illegible] carbon into three α-particles. F. K. GOWARD AN[illegible] J. J. WILKINS. *Proc. Roy. Soc. A*, **217**, 357–7[illegible] (*May* 7, 1953).

This has been determined for γ-ray energies up t[illegible] about 60 MeV from a study of 2500 stars in nuclea[illegible] emulsions. The methods used in selecting and identifying the stars are described, and full details are given of the corrections (for escape, observer efficiency etc.) required for converting the experimental data into cross-section values. The cross-section exhibits at least five resonances, situated at γ-ray energies (E_γ) of 17·3, 18·3, 21·9, 24·3 and 29·4 MeV, and a strong minimum at $E_\gamma \sim 20{\cdot}5$ MeV. This behaviour suggests that a well-defined compound nucleus is formed, the minimum near 20·5 MeV resulting from (γ, n) and (γ, p) competition. Furthermore, the finer details of the cross-section data are consistent with current knowledge of the C^{12} level structure. The integrated cross-section is $1{\cdot}21 \pm 0{\cdot}16$ MeV mb for $E_\gamma < 20{\cdot}5$ MeV, a further $2{\cdot}8 \pm 0{\cdot}4$ MeV mb for $20{\cdot}5 \leqslant E_\gamma < 42$ MeV, and $< 0{\cdot}2$ MeV mb for $42 \leqslant E_\gamma < 60$ MeV (where the symbol mb denotes 10^{-27} cm^2). As a subsidiary result of the main work, the existence of the reaction $^{13}C(\gamma, n)$ 3α has been established. A.

539.172.3

5075. Photomesonic fission of bismuth. G. Bernardini, R. Reitz and E. Segrè. *Phys. Rev.*, **90**, 573–4 (*May* 15, 1953).

The fission of bismuth by high-energy photons is detected by a photographic plate technique and some measurements on the cross-section as a function of the photon energy are reported. These suggest that the mechanism for fission is the generation of pions inside the bismuth nucleus, and their subsequent re-absorption in the same nucleus in which they have been produced. This re-absorption generates high-energy nucleons which produce the fission. A.

539.172.3

5076. Radiochemical studies on the photofission of thorium. D. M. Hiller and D. S. Martin, Jr. *Phys. Rev.*, **90**, 581–5 (*May* 15, 1953).

The relative yields of thirteen products resulting from the photofission of Th^{232} have been determined radiochemically. Photofission was induced by a 69 MeV synchrotron bremsstrahlung beam. The photofission yield curve was shown by these data to have two peaks, occurring approximately at nucleon numbers 91 and 138 with values of 6·9%. The peak-to-valley ratio was 10 and the half-width of the peaks was 12. Symmetry of the curve about nucleon number of 114·5 indicated the average emission of approximately three neutrons. The results were compared with other photofission data and the yield curves of other fission processes. A.

539.172.4

5077. (n, α) and (n, p) reactions of iron with slow neutrons. H. Hänni and J. Rossel. *Helv. phys. Acta*, **25**, *No.* 5, 521–46 (1952) *In French.*

The nuclear emulsion technique has been applied to the investigation of reactions with slow neutrons in Fe, one of several elements of middle mass which seem to have positive Q-values for (n, α)- and (n, p)-processes. The irradiated plates, loaded with Fe saccharosate or citrate, or in contact with layers of pure iron and embedded in a paraffin block, show a (n, α) and presumably also a (n, p)-effect. α and proton tracks have been discriminated by grain counting. The range distribution of α-tracks exhibits two groups at $(16 \pm 2{\cdot}5)\ \mu$ and $(24 \pm 2{\cdot}0)\ \mu$ with the corresponding Q-values $Q_1 = (4{\cdot}5 \pm 0{\cdot}5)$ MeV and $Q_2 = (5{\cdot}7 \pm 0{\cdot}3)$ MeV. The slow neutron flux, measured with plates loaded with Li and B, could be determined with an accuracy of a few points per cent. The cross-section for the total (n, α)-effect has been found to be $(5{\cdot}4 \pm 0{\cdot}8) \times 10^{-27}$ cm^2, that is ~100 times greater than the semi-theoretical expectation. The comparison of the measured efficiencies with the predicted relative probabilities and isotopic abundances, suggests Fe^{56} for the first and Fe^{57} for the second α-group. These results seem then only compatible with mass values of Ogata [Abstr. 2053 (1949)]. A.

539.172.4

5078. The (n, γ) and $(n, 2n)$ reactions in iodine. H. C. Martin and R. F. Taschek. Letter in *Phys. Rev.*, **89**, 1302–3 (*March* 15, 1953).

Absolute cross-sections have been measured for the (n, γ) reaction between 0·25 and 1·6 MeV, and for the $(n, 2n)$ reaction between 12 and 18 MeV. J. M. Cassels

539.172.4

5079. Activation cross sections measured with antimony-beryllium photoneutrons. II. C. Kimball and B. Hamermesh. Letter in *Phys. Rev.*, **89**, 1306–7 (*March* 15, 1953).

For Pt I, see Abstr. 4740 (1951).

539.172.4

5080. Neutron capture cross sections for production of Sc^{46} and Sr^{85}. W. S. Lyon. Letter in *Phys. Rev.*, **89**, 1307–8 (*March* 15, 1953).

The isotopic cross-sections for production by pile neutrons were found to be $21{\cdot}6 \pm 2$ barns (Sc^{46}) and $1{\cdot}2 \pm 0{\cdot}1$ barns (Sr^{85}). J. M. Cassels

539.172.4

5081. The formation of a compound nucleus in neutron reactions. H. Feshbach, C. E. Porter and V. F. Weisskopf. Letter in *Phys. Rev.*, **90**, 166 (*April* 1, 1953).

Regular maxima and minima are observed in the total cross-sections of the elements for neutrons up to 3 MeV. They can be explained theoretically if it is assumed that neutrons of these energies travel a mean distance of about 2×10^{-12} cm in nuclear matter before forming a compound nucleus.

J. M. Cassels

539.172.4

5082. Total cross sections for 400-MeV neutrons. V. A. Nedzel. Letter in *Phys. Rev.*, **90**, 169 (*April* 1, 1953).

Preliminary experimental results for H, C, Cu, Cd, Pb, Th and U are given. J. M. Cassels

539.172.4

5083. The thermal neutron capture cross section of hydrogen. B. Hamermesh, G. R. Ringo and S. Wexler. *Phys. Rev.*, **90**, 603–6 (*May* 15, 1953).

The thermal neutron capture cross-section of hydrogen has been measured to be $0{\cdot}329 \pm 0{\cdot}004$ b at 2200 m/sec. This was done by measurement of the reduction in the neutron activation rate of NaI in a water solution when boron of a known absorption cross-section was added to the solution. A.

539.172.4

5084. The total neutron cross sections of gold, chlorine, and phosphorus. S. C. Snowdon and W. D. Whitehead. *Phys. Rev.*, **90**, 615–18 (*May* 15, 1953).

The total neutron cross-sections of gold, chlorine and phosphorus have been measured over the energy range 100 to 700 keV using the mono-energetic neutrons from the $H^3(p, n)He^3$ reaction with an energy resolution of about 40 keV. Pronounced resonances were found in phosphorus, slight indications of resonances were found in chlorine and no resonances were found in gold. A.

539.172.4

5085. Total cross sections of chlorine, sodium, titanium, and bromine for fast neutrons. H. R. Dvorak and R. N. Little, Jr. *Phys. Rev.*, **90**, 618–22 (*May* 15, 1953).

Relatively new liquid scintillation counter methods were adapted to detect fast neutrons with a heretofore unattainable efficiency of about 19%. The geometry obtained was the so-called "good" geometry, which was a half-angle at the counter of 2·7°. With the more efficient counter reasonable counting times could

be obtained with the detector subtending a half-angle of only 2·7° from the target. The neutrons were obtained by using a modified Cockcroft–Walton linear accelerator of 100 keV bombarding energy. The neutron energy range was 2·15 to 2·82 MeV. All the scatterers used were contained in almost identical glass "cells," and the effects of the glass cells were subtracted out by using an empty glass cell of the same type as a reference. The probable error, calculated statistically from the counting rates of the experiment, was 1·3% on total cross-section values. Actual reproducibility of each result was about 3% or better. A carbon cross-section curve was obtained as a check on this method, and agreement with previously reported values was excellent. The chlorine and sodium cross-sections were found to be about 3×10^{-24} cm², as determined indirectly by using carbon tetrachloride and sodium chloride. The titanium cross-section was found to be about $4\cdot1\times10^{-24}$ cm² by using powdered titanium metal. The bromine cross-section was found to be about $3\cdot7\times10^{-24}$ cm², by using a sample of liquid bromine. No large resonances were found in the energy region available. Data were also taken on the angular distribution of the number of neutrons with respect to the forward direction of the incident deuteron beam, and they were found to agree well with theory except in the region where experimentally necessary geometric conditions dictated a deviation. A.

539.172.4 : 539.155.2

Neutron capture cross-sections of neodymium isotopes. *See Abstr.* 4971

539.172.4 : 539.163.1

5086. Thermal neutron capture cross-section of Na^{23} and Mn^{55}. R. M. Bartholomew, R. C. Hawkings, W. F. Merritt and L. Yaffe. *Canad. J. Chem.*, **31**, 204–6 (*May*, 1953).

The cross-sections have been determined using the activation method. The values are 0·53 ± 0·03 and 12·7 ± 0·3 barns respectively with respect to Au^{197} = 93 barns. These agree well with recent pile oscillator results. The half-life for Mn^{56} is found to be 2·576 ± 0·002 hr. A.

539.172.4 : 539.163.2

Neutron activation cross-section of Pd^{102}. *See Abstr.* 5005

539.172.4 : 778.34

5087. Angular distribution of particles from stars. R. W. Waniek and T. Ohtsuka. Letter in *Phys. Rev.*, **89**, 1307–8 (*March* 15, 1953).

The angular distribution in space has been measured for each "prong" of about 1000 nuclear disintegration stars induced by high-energy neutrons in 200 μ Ilford G.5 emulsions. For disintegrations having up to 3 "prongs" the observed forward tendency in the emission of both low- and high-energy particles is ascribed to the high-energy peak in the neutron spectrum. The angular distribution is nearly isotropic for larger disintegrations. A. C. Coates

539.172.4

5088. The fission yield of Te^{134}. L. Yaffe, A. E. Day and B. A. Greer. *Canad. J. Chem.*, **31**, 48–54 (*Jan.*, 1953).

The yield has been found to be 6·48% ± 0·47%. This makes the cumulative yield of I^{134} 7·71% using Glendenin's value of 0·19 as the independent fra tional chain yield of I^{134}. This value, since it is ve close to that found by Thode for Xe^{134}, offers add tional confirmation of the 54 min iodine assignme to mass 134.

539.172

5089. The independent yield of Xe^{135} produced in t fission of natural uranium by pile neutrons. F. Brov and L. Yaffe. *Canad. J. Chem.*, **31**, 242–9 (*Mar* 1953).

Fission of uranium yields Xe^{135} by two route direct production and production by the β-decay I^{135}. The amount produced directly (independe yield) has been measured by comparison with t amount produced from I^{135}. The independent fissi yield of Xe^{135} is found to be 2·7 ± 1·0% of t cumulative yield of I^{135}. Assuming this latter quanti to be 5·6% of all fissions, the independent yield Xe^{135} is ~0·15%. The half-life of Xe^{135} has bee measured as 9·13 ± 0·05 hr.

539.172

5090. The capture and loss of electrons by fissi fragments. G. I. Bell. *Phys. Rev.*, **90**, 548– (*May* 15, 1953).

The effective charge of fission fragments passi through a low pressure gas is calculated. On a class cal basis, the cross-section for capture of an electr by a fission fragment of relatively arbitrary char and velocity is computed, and then a rough theo developed which gives the cross-section for loss of a electron through interaction with a gas atom. Fro these two cross-sections the effective charge obtained. The effective charge of a fragment wi increase with the pressure of the substance throug which it passes. The probable importance anomalous effects in hydrogen and helium is note General agreement between theoretical prediction and experimental results is found.

539.172.4 : 539.163

5091. The fission yield of I^{131} in the thermal neutr fission of U^{235}. R. M. Bartholomew, F. Brow R. C. Hawkings, W. F. Merritt and L. Yaff *Canad. J. Chem.*, **31**, 120–5 (*Feb.*, 1953).

The fission yield of I^{131} has been investigated usin improved extraction techniques and disintegration rat measurements. The value obtained is (3·1 ± 0·1)% This is relative to a Ba^{140} reference fission yield c 6·1%. The half-life for I^{131} has been determined an found to be 8·05 ± 0·01 days.

539.172

5092. The approach to criticality of a cylindrical pil J. F. Hill. *Atomic Energy Res. Establ.* [*Harwell Mem. R/M5*, 4 *pp.* (1951).

Theoretical confirmation is given of the exper mental result that if the number of channels in sub-critical pile is divided by the neutron flux at th centre of the pile and then plotted as a function of th number of channels, the resulting curve is a straigh line along a substantial part of its length.

539.172.

5093. One and two group theory of cylindrical piles J. F. Hill. *Atomic Energy Res. Establ.* [*Harwell Rep. T/R*170, 34 *pp.* (1949).

The equations describing the behaviour of th

thermal neutron flux on the basis of a one-group theory are developed for a cylindrical pile when: (*a*) the pile is not surrounded by a reflector; (*b*) the pile is surrounded by a radial reflector only; (*c*) the pile has end reflectors only; (*d*) the pile is completely surrounded by a reflector. In the latter case only an approximate treatment is given. The corresponding equations for the thermal and fast neutron fluxes are developed for the two-group neutron theory case. Expressions for the ratio of the average to maximum thermal neutron flux both radially and axially are given and a scheme presented for calculating the actual thermal flux in the metal at the centre of the pile and hence the average thermal neutron flux over a lattice cell at the centre of the pile. A.

539.172.4

5094. A method of calculating the critical dimensions of spherically symmetrical reactors. I. H. M. MELVIN. *Atomic Energy Res. Establ.* [*Harwell*] *Rep. T/R*586, 7 *pp.* (*Oct.*, 1950).

A method is described for comprising a homogeneous core of fissile matter contained in an infinite homogeneous tamper of scattering and absorbing, but non-multiplicative, material. A.

539.172.4

5095. A method of calculating the critical dimensions of spherically symmetrical reactors. II. Systems with a finite tamper. H. M. MELVIN. *Atomic Energy Res. Establ.* [*Harwell*] *Rep. T/R*587, 13 *pp.* (*Oct.*, 1950).

The method described in the first report (abstract preceding) is adapted to the calculation of the critical dimensions of a homogeneous sphere of fissile material embedded in a homogeneous concentric spherical tamper of finite dimensions. A.

539.172.4 : 539.185.08

5096. The measurement of an absolute thermal neutron density in G.L.E.E.P. D. J. LITTLER AND E. E. LOCKETT. *Atomic Energy Res. Establ.* [*Harwell*] *Rep. R/R*961, 15 *pp.* (*Sept.* 5, 1952).

By measuring the thermal neutron absorption cross-section of Na on the G.L.E.E.P. oscillator, and by irradiating samples of Na_2CO_3 at the centre of G.L.E.E.P., and subsequently determining the absolute β-activity of these samples, an absolute thermal neutron density at the centre of the pile has been measured. This neutron density can be reproduced accurately by measuring the current from a boron-coated ion chamber situated near the centre of the pile. The density is at present expressed in terms of the thermal neutron absorption cross-section of a particular sample of boron. An absolute measurement of this cross-section is being made, but has not yet been completed. The accuracy of the density determination is $\pm 4\%$, but this error will have to be increased statistically by the error on the determination of the boron cross-section. The thermal neutron density which can be provided covers the range of approximately 10 to 2×10^4 n/cm³. A.

539.172.4

5097. Method of counting permitting the measurement of the multiplication factor in a pile. V. RAIEVSKI. *C.R. Acad. Sci.* [*Paris*] **236,** 693–5 (*Feb.* 16, 1953) *In French.*

Discusses theoretically the use of the measurement of neutron population in a subcritical pile. F. R. HOLT

539.172.4 : 621.039.42 : 620.9

5098. Nuclear reactors and their applications. J. COCKCROFT. *Proc. Instn Elect. Engrs, I,* **100,** 83–9 (*May*, 1953).

A lecture, delivered to The Institution of Electrical Engineers, outlining the problems involved in the design of nuclear reactors and the economic aspects of the generation of electricity, using natural uranium or breeder reactors as energy sources. L. R. SHEPHERD (R)

ATOM AND MOLECULE BEAMS . MESONS NEUTRONS 539.18

539.18

5099. On the decay of the π-meson. B. IOFFE AND A. RUDIK. *Dokl. Akad. Nauk SSSR,* **82,** *No.* 3, 359–60 (1952) *In Russian.*

The differential cross-section for $\pi = \mu + \nu + \gamma$ is calculated using a coupling of the type $g(\bar{\phi}_\nu\phi_\mu)\psi_\pi$ and $g(\bar{\phi}_\nu\gamma_5\phi_\mu)\psi_\pi$. The infrared divergence is avoided and the result shows that the fraction of cases in which the μ has a range kx (maximum possible) decreases from 4×10^{-4} at $k = 0{\cdot}9$ to $0{\cdot}1\times10^{-4}$ at $k = 0{\cdot}2$.

W. J. SWIATECKI

539.18

5100. The production of π-mesons by γ-rays on deuterium. B. L. IOFFE AND I. M. SHMUSHKEVICH. *Dokl. Akad. Nauk SSSR,* **82,** *No.* 6, 869–72 (1952) *In Russian.*

The differential and total cross-sections for $\gamma + d \rightarrow n + n + \pi^+$ or $p + p + \pi^-$ are worked out in non-relativistic perturbation theory for ps. scalar mesons with both kinds of coupling. The resulting connection with cross-sections for $\gamma + p$ or n is confirmed using a phenomenological treatment which is then applied to the photoproduction on p or d of scalar or ps. scalar π^0 and of charged vector and ps. vector π's. The effect of the other nucleon is greater in the last case. W. J. SWIATECKI

539.18

5101. On the meson production in the collision of energetic nucleons. K. GOTTSTEIN AND M. TEUCHER. *Z. Naturforsch.,* **8a,** 120–6 (*Feb.–March*, 1953) *In German.*

A detailed analysis of the energy and angular spectrum of a $0 + 20p$ star is compared with the predictions of Heisenberg's shock-wave theory. General consistency is found. W. J. SWIATECKI

539.18

5102. Photoproduction of neutral mesons in hydrogen at high energies. R. L. WALKER, D. C. OAKLEY AND A. V. TOLLESTRUP. Letter in *Phys. Rev.,* **89,** 1301 (*March* 15, 1953).

Measurements were made for γ energies of 280–450 MeV by observing the recoil protons in coincidence with one decay γ from the π^0. The absolute cross-section (consistent with the 200–300 MeV measurements of Silverman and Stearns) rises to a maximum of $1{\cdot}8\times10^{-29}$ cm²/ster at 320 MeV, then falls to $0{\cdot}5\times10^{-29}$ at 450 MeV. W. J. SWIATECKI

539.18

5103. Production and scattering of mesons. J. C. GUNN. *Advances in Phys.,* **2,** 213–64 (*April*, 1953).

A review article: Kinematics of meson reactions;

meson theory formalisms. Photoproduction and scattering of π^+, π^- or π^0 in H, D and complex nuclei. Production in nucleon-nucleon or -nucleus collisions. A detailed account of the experimental results in each case is followed by accounts of the principal theoretical calculations. A discussion of the present state of the theories and of outstanding questions. About 120 references. W. J. SWIATECKI

539.18

5104. Direct experimental evidence for the existence of a heavy positive *V*-particle. C. M. YORK, R. B. LEIGHTON AND E. K. BJORNERUD. Letter in *Phys. Rev.*, **90**, 167 (*April* 1, 1953).

The indications that of 53 *V*-particles observed in a cloud chamber some are longer lived (10^{-9} sec) than others (10^{-10} sec) is supported by an analysis of two *V* events with a secondary of mass 1300–2300m_e, and consistent with the decay of a heavy V_1^+ into $P + \pi^0 + (Q \sim 40$ MeV). W. J. SWIATECKI

539.18

5105. Elastic pion-deuteron scattering. E. ARASE, G. GOLDHABER AND S. GOLDHABER. Letter in *Phys. Rev.*, **90**, 160 (*April* 1, 1953).

Using energy and momentum balance 27 events in D_2O loaded emulsions irradiated with 3×10^4 cm^{-2} 140 MeV π^--mesons could be identified as $\pi^- + D$ elastic scatterings. A forward peak was found.

W. J. SWIATECKI

539.18

5106. The elastic scattering of π-mesons by deuterons. T. A. GREEN. Letter in *Phys. Rev.*, **90**, 161 (*April* 1, 1953).

The cross-section for 135 MeV π's was calculated in the impulse approximation of Fernbach *et al.* (1951) by using Fermi's phase-shift analysis of π–nucleon scattering. The results are 2–4 times the observed values for $\theta = 30$ to 180° (preceding abstract). Possible sources of error are suggested.

W. J. SWIATECKI

539.18

5107. Production of negative μ-mesons and their behavior in nuclear research emulsions. D. F. SHERMAN. *Phys. Rev.*, **90**, 469–72 (*May* 1, 1953).

A beam of negative μ-mesons produced inside the tank of the 184-in cyclotron has been studied. $2{\cdot}7 \pm 1\%$ formed one-prong stars when stopped in Ilford C2 emulsion. Two two-prong stars with prong ranges of 2 or 3 microns were observed which appear to be fission-like disintegrations induced by μ^--capture. 32% of the μ^--mesons have clusters of grains about 1 micron in diameter or two pronglets about one micron long at their termini. These are interpreted as Auger electrons accompanying capture by a heavy nucleus, or in some cases as fission of the capturing nucleus. An upper limit on the cross-section for direct production of negative μ-mesons, $d\sigma/d\Omega dp$, in the forward direction at $pc = 129$ MeV, has been evaluated to be $0{\cdot}015$ times the cross-section for production of negative π-mesons in the same interval.

A.

539.18

5108. Mean lifetimes of *V*-particles and heavy mesons. W. L. ALFORD AND R. B. LEIGHTON. *Phys. Rev.*, **90**, 622–9 (*May* 15, 1953).

A maximum-likelihood procedure for determining mean lifetimes of *V*-particles from cloud-chambe data is applied to samples taken from a group c 134 neutral *V*-particle decays. For 74 events whic were consistent with a decay into a proton and negative π-meson, a lifetime of $(2{\cdot}5 \pm 0{\cdot}7)\times$ 10^{-10} sec is obtained. Dividing the data into "lov Q" and "high Q" groups on the basis of the calculate energy release in the decay, a value of $\tau_L = (2{\cdot}9 \pm 0{\cdot}8)\times10^{-10}$ sec is found for those cases wit $0 \leqslant Q \leqslant 50$ MeV and a value of $\tau_H = (1{\cdot}6 \pm 0{\cdot}5$ $\times10^{-10}$ sec is found for those cases with $50 < Q \leqslant$ 150 MeV. While no significant difference exist between these two values, the difference is greate than for other plausible division schemes which ar considered. A qualitative discussion of lifetimes i given for the case of 23 charged *V*-particle decays For the charged *V*-particles these data suggest either a lifetime less than that of the neutral *V*-particles provided the sample is homogeneous, or, more likely, an apparent average lifetime less than that o the neutral *V*-particles, if the sample is a mixture o two or more types of particles. The possibility that κ and/or χ-mesons make up a part of these decays is considered.

A.

539.18 : 541.18.043 : 539.4 : 531.38

Some scientific applications of high speed rotation. *See Abstr.* 4627

539.18 : 778.34

5109. Nuclear interactions of 210-MeV π^--mesons in emulsions. A. H. MORRISH. *Phys. Rev.*, **90**, 674–7 (*May* 15, 1953).

A study has been made of the interactions of 210 ± 20 MeV π^--mesons with the nuclei of photographic emulsions which were exposed to the University of Chicago synchrocyclotron. Detailed classification of the events into elastic and inelastic scatterings, stops and stars, permitted some discussion of the mechanisms involved. The mean free path for a nuclear interaction was found to be $25{\cdot}7$ cm, as determined from an examination of 2823 cm of track. The increase in this mean free path over that observed at lower energies at Columbia appears to be primarily due to a decrease in the probability for π^--meson absorption in a nuclear collision.

A.

539.181

5110. Scattering experiments with crossed molecular beams. W. JAWTUSCH. *Z. Phys.*, **133**, *No.* 4, 541–57 (1952) *In German.*

The angular distributions were measured for a potassium beam scattered by: (1) residual gas in the vacuum system at various pressures and (2) by a second beam at 90° consisting of (*a*) Hg, (*b*) heavy organic molecules. The scattered K atoms were detected through ionization by a W filament and amplification of the resulting current to give a sensitivity of 10^{-14} amp. Strong forward scattering was found and cross-sections several times the gas-kinetic values were deduced. W. J. SWIATECKI

539.185

5111. Nuclear recoil and detection of the neutrino. O. KOFOED-HANSEN. *Physica*, **18**, 1287–1301 (*Dec.*, 1952).

A summary and interpretation of β-recoil (and *K*-capture) experiments (including projected experiments) where an energy determination has been

attempted. The case of meson decays $\pi \rightarrow \mu + \nu$, $\mu \rightarrow \beta + 2\nu$ is mentioned. The effect of a neutrino mass on the β spectrum and ft value is discussed and an upper limit $m_\nu \lesssim 5$ keV is estimated. Neutrino absorption experiments (e.g. $\nu + Cl^{37} \rightarrow A^{37} + e^-$) are reviewed. 46 references. W. J. SWIATECKI

539.185

5112. A proposed experiment to detect the free neutrino. F. REINES AND C. L. COWAN, JR. Letter in *Phys. Rev.*, **90**, 492 (*May* 1, 1953).

The suggested experiment uses about 10 ft³ of liquid scintillator in which the neutrinos, from β-decay of fission fragments in a pile, convert protons into neutrons with positron emission (0·1 c/min expected from latter). Loading the scintillator with B or Cd allows the n-capture γ-rays to be counted in delayed coincidence with positron and annihilation pulses, thus reducing background which must be further reduced by shielding and G.M. umbrellas to remove pulses from μ-meson decay and stars, etc.

G. F. J. GARLICK

539.185

5113. The scattering of fast neutrons by complex nuclei. G. MEMMERT. *Z. Phys.*, **134**, *No.* 1, 42–65 (1952) *In German.*

An attempt to interpret the experimental cross-sections up to 300 MeV within the framework of the optical model. The problem of the scattering by a complex potential well is set up and solutions for $l + \frac{1}{2} \ll kR$ used to derive an approximate formula for all phases up to $l + \frac{1}{2} \sim kR$. This is used to deduce scattering and absorption cross-sections, the exclusion principle being taken into account by a reduction factor q. Comparison with experiment is difficult owing to the arbitrariness in the experimental definition of inelastic scattering as given by the thresholds of the neutron detectors. Confining oneself to total cross-sections the general features of the experiments can be reproduced with an $A^{\frac{1}{3}}$ radius, equal n-n and n-p cross-sections and a constant q, but with a refractive index which above 90 MeV approaches 1 much more rapidly than estimated from the Fermi gas model. From measurements at 280 MeV the value $\sigma_{nn} = 16 \times 10^{-27}$ cm² is deduced.

W. J. SWIATECKI

539.185

5114. On the slowing down of neutrons in heavy water. G. HOLTE. *Ark. Fys.*, **6**, *Paper* 24, 243–54 (1953).

A method developed in a previous paper by the same author [Abstr. 4760 (1951)] is used to calculate the space energy distribution of slow neutrons in an infinite volume of heavy water containing a fast neutron point source. Inelastic scattering is neglected and there is assumed to be no absorption. A correction is made, for the anisotropy in the centre of mass space, of the first few scattering collisions when the neutron energy is high. This only affects the distribution at very large distances from the source. Results are given, for the distribution of 1 eV neutrons with initial energies of 0·5, 1·0 and 1·5 MeV. Comparative results on the age-theory are included. It is found that the age-theory gives too few neutrons at low values of r, up to 15 cm, and too many at intermediate range up to about 40 cm. L. R. SHEPHERD

539.185

5115. Measurement of the transport mean free path of thermal neutrons in D_2O by a boron poisoning method. S. W. KASH AND D. C. WOODS. *Phys. Rev.*, **90**, 564–6 (*May* 15, 1953).

The transport mean free path of thermal neutrons in D_2O was experimentally determined by measuring the change in the relaxation length upon the introduction of known amounts of B_2O_3. The value found for 99·7% pure D_2O was $2{\cdot}49 \pm 0{\cdot}04$ cm. Upon correcting for the small hydrogen impurity, a value of $2{\cdot}52 \pm 0{\cdot}04$ cm was obtained for λ_{tr} in pure D_2O.

A.

539.185.08

5116. A method of measuring the average energy of a neutron spectrum in the range 0·3 to 3·0 MeV. M. E. MANDL. *Atomic Energy Res. Establ.* [*Harwell*] *Rep. T/R* 1008, 13 *pp.* (*Aug.*, 1952).

The average energy is deduced (accuracy about 20%) from the shape of the induced thermal neutron spatial distribution in a sphere of paraffin. Where time and space allow, and where very great accuracy is not necessary, e.g. in animal irradiation experiments with neutrons of > 1 MeV, this method has considerable advantages due to its simplicity. The method has been checked experimentally at energies of 0·6 and 2·9 MeV, where it is in good agreement.

539.185.08

5117. Absolute neutron density determinations using cobalt. D. J. LITTLER AND R. H. THOMAS. *Atomic Energy Res. Establ.* [*Harwell*] *Rep. R/R* 1019, 8 *pp.* (*Sept.* 16, 1952).

Cobalt wire may be used for the absolute integration of thermal neutron density over any period of time up to several years. Thermal neutron densities in B.E.P.O. have been measured by irradiating together cobalt wires and sodium carbonate. The absolute values agree to ±4%.

A.

539.185.7

5118. On the mean values used in the slowing down of neutrons. R. WALEN. *Recueil Trav. Inst Mat. Rech. Struct. Matière* [*Belgrade*] **1**, 17–29 (*July*, 1952) *In French.*

In calculations of the diffusion of neutrons the mistake is often made of identifying the mean logarithm of the energy with the logarithm of the mean energy. It is shown that the use of the correct mean values does not introduce any serious complication in either simple or complicated cases. J. THEWLIS

539.185.85

5119. Determination of the diffusion length of thermal neutrons in graphite. L. CARLBOM. *Ark. Fys.*, **6**, *Paper* 32, 335–48 (1953).

A 12½ ton pile of graphite blocks was irradiated by D–D neutrons from a 200 kV H.T. set. The graphite had an average density of 1·65 g. cm⁻³, and analyses of a sample block had shown boron contaminations ranging from 5 p.p.m. at the edges to 1 p.p.m. in the centre. The distribution of thermal neutrons in the pile was surveyed by activating Mn–Ni alloy foils, and the diffusion length found to be $45{\cdot}4 \pm 0{\cdot}2$ cm.

J. M. CASSELS

539.185.9

5120. Energy flux and average energy of neutrons scattered by the walls of a laboratory. M. E. MANDL. *Atomic Energy Res. Establ.* [*Harwell*] *Rep. T/R* 727, 11 *pp.* (1951).

The energy flux of neutrons scattered back to the source is calculated for a source at the centre of a spherical room. The average energy of the returned neutrons is calculated by comparison with a formula given in an earlier report for the neutron flux. The walls of the room are assumed to be of some non-capturing material having scattering properties similar to concrete. A.

STRUCTURE OF SOLIDS 539.2

539.217

5121. Auto-diffusion in lead oxide. R. LINDNER. *Ark. Kemi*, **4**, *Paper* 27, 385–8 (1952) *In German.*

To obviate errors caused by the volatilization [evaporation] of thin layers of radioactive indicators at elevated temperatures, a "contact" method has been developed consisting in pressing together two sintered tablets, made of activated and unactivated yellow PbO, respectively. The following relationship has been found for the temperature dependence of the diffusion constant: $D = 10^5 \exp(-66\,000/RT)$ $cm^2\ sec^{-1}$. F. LACHMAN

539.217

5122. Diffusion of D_2 from D_2O through steel. F. J. NORTON. Letter in *J. appl. Phys.*, **24**, 499 (*April*, 1953).

That the H_2 which is known to permeate through steel during its corrosion in damp air is derived from the initial reaction $Fe + H_2O \rightarrow FeO + H_2$, rather than from H_2 already in the metal, was demonstrated by substituting D_2O for H_2O, when D_2 was found to permeate the metal. A. D. LE CLAIRE

539.219

5123. Anelastic effects in iron containing vanadium and nitrogen. J. D. FAST AND J. L. MEIJERING. *Philips Res. Rep.*, **8**, 1–20 (*Feb.*, 1953).

The maximum quantity of N taken up by a Fe wire containing 0·5 atomic % vanadium during heating at 950°C in N_2 with 1% H_2 corresponds to 1 atom N for 1 atom V plus an extra amount of the same order as the quantity taken up by pure Fe under identical conditions. The first amount combines chemically with the vanadium and causes no internal friction. The extra amount gives rise not only to a damping peak corresponding to that in pure iron (at 21·5°C for an oscillation period of 1·3 sec), but also to a peak at higher temperatures. This peak cannot be described with a single relaxation time only. It is due to the presence of VN particles in the metal. These do not directly cause damping, but create interstitial sites around themselves where the free N atoms are bound much tighter than in the normal interstices. These abnormal interstices, therefore, will capture free N atoms rapidly, whereupon these give rise to the abnormal damping. The binding energy in the abnormal interstices is not the same for all, and with coarsening of the VN precipitat the distribution of these energies is displaced towarc the side of stronger binding. This is deduced from shift of the summit of the second peak toward higher temperatures (from 80°C to 88°C in thes experiments) caused by prolonged heating at 950°C From the intermediate state where they cause th abnormal damping, the N atoms pass over rathe rapidly into the fully precipitated state (iron nitride where they cause no damping. Consequently, th VN precipitate exerts a strongly accelerating influenc on the precipitation of dissolved nitrogen. A

539.22

5124. Thin films. *Atomic Energy Res. Establ* [*Harwell*] *Rep., C/R* 861, 43 *pp.* (1952).

A symposium sponsored by the Chemistry Division A.E.R.E., Harwell (March, 1951). Mainly devotec to discussion of the practical details of preparation and their effects on properties.

539.23 : 541.135

5125. Ionic current and film growth of thin oxide layers on aluminium. A. CHARLESBY. *Proc. Phys. Soc.* [*London*] *B*, **66**, 317–29 (*April*, 1953).

Describes part of a series of investigations into the electrical properties of thin insulating oxide layers formed electrolytically on aluminium, and is limited to a study of the ionic current and the resultant film growth. It is shown that at a given temperature the ion current i is a function of the average electrostatic field strength F across the film. Two forms of the function $i = f(F)$ previously proposed are considered. They have been investigated in three ways: (i) ion current as a function of applied voltage V_f at constant film thickness δ; (ii) current decay with time during formation at constant formation voltage; (iii) change of film thickness or capacity with time at constant formation voltage. These results tend to favour the exponential relationship $i = A \exp BF$ with $A = 10^{-18}$ A/cm² and $B = 3 \times 10^{-6}$ cm/V at room temperature. The law of film growth derived is only approximately logarithmic, whilst during current decay $i \sim 6 \times 10^{-5}\ V_f/t$. At higher temperatures it is shown that the approximately logarithmic law is replaced by a cubic law over a short range of temperatures, and subsequently by a quadratic law. The application of these results to oxidation in air is discussed. A.

539.234 : 535.361.2

5126. The effect of vapor incidence on the structure of evaporated aluminum films. L. HOLLAND. *J. Opt. Soc. Amer.*, **43**, 376–80 (*May*, 1953).

It is well known that evaporated aluminum films develop a diffuse reflecting surface as their thickness increases, but it is not generally appreciated that the limiting thickness at which light scattering appears decreases as the incidence angle of the vapour atoms arriving at the condensing surface increases. Aluminum films formed at 80° incidence have a greater absorption than those condensed at normal incidence and develop a diffuse reflecting surface before becoming opaque. The film surface density at which diffuse reflection appeared at different vapour incidence angles was determined by measuring the specular reflectivity of the film for blue light at nearly

normal incidence. It is shown that a diffuse reflecting surface is formed more easily as the vapour incidence angle approaches grazing incidence because the vapour atoms are mainly deposited on the upper surface of the film nuclei, the most elevated of which tend to grow in the direction of the vapour beam. A.

539.24 : 539.27

5127. Summarized proceedings of a conference on the optical and electron-microscopical properties of textile fibres—Manchester, October 1952. D. G. DRUMMOND. *Brit. J. appl. Phys.*, **4**, 119–24 (*April*, 1953).

Eight papers were read and discussed in two sessions: one on electron-optical topics and the other on ordinary optical topics. The papers and discussion are summarized in this article. A.

539.27

5128. On the electron microscope examination of sections of textile fibres by a double replica method. P. KASSENBECK AND J. J. TRILLAT. *C.R. Acad. Sci.* [*Paris*] **236**, 369–71 (*Jan.* 26, 1953) *In French.*

The fibres were mounted in methyl-methacrylate blocks. Polystyrene–SiO replicas were made of polished sections of the block. Micrographs of sections of rayon, terylene and wood fibres are shown. R. S. PEASE

539.27

5129. The origin of specimen contamination in the electron microscope. A. E. ENNOS. *Brit. J. appl. Phys.*, **4**, 101–6 (*April*, 1953).

Electron beam contamination has been studied in simple vacuum systems to determine how it originates and methods by which it may be prevented. It is concluded that the contamination is formed by the interaction of the electrons with organic molecules adsorbed on the bombarded surfaces, the molecules being replenished from the vapour phase. Contamination may be prevented by heating the bombarded surface or surrounding it with an efficient cold trap. A.

539.27

5130. Object changes in the electron microscope in relation to beam intensity. L. WEGMANN. *Optik*, **10**, *No.* 1–3, 44–59 (1953) *In German.*

A description is given of the changes which occurred in the image of a metal-shadowed cellulose specimen as the electron beam intensity and duration were altered. When the energy loading in the object plane exceeded about 1000 W/cm^2, a levelling of the structure began, accompanied by a loss in contrast in the image. Preparations treated with gold showed minute recrystallization of the gold at energy loadings of about 500 W/cm.^{2} H. J. H. STARKS

539.27

5131. Extended interference streaks on electron microscope pictures of organic substances. H. WESTERMANN AND G. PFEFFERKORN. *Optik*, **10**, No. 1–3, 60–3 (1953) *In German.*

Hitherto interference streaks on electron microscope photographs have been observed only with inorganic single crystals. The authors observe streaks, however, with dried specimens of electrolyte-containing proteins which are shown by electron diffraction to arise from the polycrystalline organic material. Single crystals of NaCl are also present. J. THEWLIS

539.27

5132. Origin of streaky pictures with thin crystals. R. BERNARD AND E. PERNOUX. *Optik*, **10**, *No.* 1–3, 64–71 (1953) *In German.*

An extension of previous work, discussing the occurrence of streaks on electron microscope photographs. In addition to the three types of effect previously described [Abstr. 4656 (1952)] a fourth type is now observed in MoO_3 and PbI_2. This is described as a system of streaks with a centre of symmetry, the symmetry being related to the crystal structure in each case. The effects are diffraction effects, arising only after long exposures and their origin is discussed in detail. J. THEWLIS

539.27

5133. Making vacancies in single crystal lamellae visible in the electron microscope. G. MÖLLENSTEDT. *Optik*, **10**, *No.* 1–3, 72–89 (1953) *In German*

It is shown that in most instances the occurrence of interference lines in electron microscope photographs arises from the bending of single crystal lamellae. But in the case of PbI_2 effects are observed which are analogous to Kossel lines on the assumption that vacancies exist in the crystal. J. THEWLIS

539.27

5134. The assessment of objects in the electron microscope by rotating the specimen. R. RÜHLE AND E. ZEHENDER. *Optik*, **10**, *No.* 1–3, 111–15 (1953) *In German.*

By rotating the specimen through a small angle without displacing the image (as can be done in the Bosch electron microscope), a spatial impression of an object can be obtained and stereoscopic photographs can be taken in rapid succession, thereby reducing the effects of changes in the object and in the voltage supplies. Crystalline specimens can be detected at once by the differences in the reflections from the different crystalline surfaces. The method is illustrated by photographs of Zn and Mo oxide layers taken as the specimen is rotated. H. J. H. STARKS

539.27

5135. Evaluation of electron images of powdered materials. R. BERNARD AND F. DAVOINE. *Optik*, **10**, *No.* 1–3, 150–5 (1953) *In German.*

The results are given of a determination with the electron microscope of the particle diameter distribution of a fine powder (W carbide) after various periods of grinding obtained by counts made with a graticule superposed on the magnified images (10 000×) of the powder. H. J. H. STARKS

539.27

5136. Electron microscope analysis of deposited layers. E. ZEHENDER. *Optik*, **10**, *No.* 1–3, 156–62 (1953) *In German.*

Images produced in the electron microscope of metal vapour deposited films by using a slightly inclined electron beam can show more contrast when the film is heterogeneous than when the beam is normally incident on the specimen. Photographs are

reproduced showing $Cd(OH)_2$ inclusions in a Cd film and the distribution of oxide in a Zn film which with normal illumination are barely visible.

H. J. H. STARKS

539.27 : 541.15

5137. Changes in $KMnO_4$ under electron bombardment in relation to its thermal decomposition. O. GLEMSER AND G. BUTENUTH. *Optik*, **10**, *No.* 1–3, 42–3 (1953) *In German.*

Using the electron microscope, the products produced by the decomposition of $KMnO_4$ by electron beams of different intensity were identified. These were different to those obtained by heating.

H. J. H. STARKS

539.27 : 551.575.1

Electron-microscope study of fog nuclei. *See Abstr.* 5244

539.27 : 551.578.41

Electron-microscope study of snow-crystal nuclei. *See Abstr.* 5245–6

539.27 : 621.385.833

5138. The scanning electron microscope and the electron-optical examination of surfaces. D. MCMULLAN. *Electronic Engng*, **25**, 46–50 (*Feb.*, 1953).

Describes an electron microscope for the examination of surface structure. The surface to be examined is scanned by a fine-focus electron beam and the scattered beam from each point examined is amplified by an electron multiplier, the multiplier current being fed to a c.r.t. to give a television-type presentation. The electron spot has a diameter of 200–1000 Å, and the accelerating voltage of the microscope is variable between 5 and 40 kV. In the microscope there are 405 lines per picture and 0·9 pictures per second for direct viewing, and for recording there are 550 lines and one picture in 300 sec. J. THEWLIS

ELASTICITY . STRENGTH . RHEOLOGY
539.3/.8

539.3 : 536.37

5139. Study of the heat evolved in the extension and relaxation of rubber. J.-P. EHRBAHR. *Experientia*, **9**, *No.* 5, 177–8 (1953) *In French.*

The heat produced by strain on a sample of vulcanized rubber is freed at an exponential rate, the constant k of which does not depend on strain. A period of crystallization (half-reaction time) amounting to about 20 min may be thus defined at room temperature.

A.

539.313

5140. Relations between stresses and deformations in the most general classical medium deformed isothermally. C. PLATRIER. *Bull. Acad. Roy. Belgique Cl. Sci.*, **38**, *No.* 10, 975–7 (1952) *In French.*

The equations of equilibrium and boundary conditions are expressed in terms of an unsymmetrical stress tensor which has one contravariant suffix referring to current co-ordinates and one referring to the initial co-ordinates of the material with which it is associated. The stress components are defined in terms of the derivatives of an arbitrary isothermal strain-energy function with respect to strain components.

J. G. OLDROYD

539.37

5141. Deformation by repeated blows of annealed polycrystalline aluminium. Y. PIRONNEAU. *C.R. Acad. Sci.* [*Paris*] **236**, 1231–4 (*March* 23, 1953) *In French.*

As previously found for Al–Cu alloys [Abstr. 365 (1953)], the deformation is, to a first approximation, proportional to the number of blows, and therefore to the energy absorbed. A principle of superposition is established, that the deformation produced by a number of blows of different intensity is independent of the order in which they are applied. More precise measurements show, just as for ordinary deformation, a transition, at ~2% strain, from a region of relatively easy deformation to one where the hardening varies regularly with deformation.

A. D. LE CLAIRE

539.37

5142. Instruments for measuring plasticity in the rubber industry. J. R. SCOTT. *J. sci. Instrum.*, **30**, 145–50 (*May*, 1953).

The uses of plasticity tests and the rheological behaviour of unvulcanized rubbers and mixed stocks are described. The complexity of this behaviour restricts the use of simple plasticity tests to checking uniformity of repeat batches and testing liability to premature vulcanization, which causes marked stiffening. The following main types of plastimeter used for rubber are discussed. *Extrusion.* As there is some slip between the rubber and the wall of the nozzle, extrusion instruments do not measure true plasticity, though the results may correlate with behaviour in an extrusion machine and thus be a useful test of "extrudibility." *Rotation.* The rotation principle furnishes the best research instrument because shear rate can be varied widely and time (thixotropic) effects studied. Coaxial cylinder instruments have been used for research; shearing between parallel disks, one fixed and one rotating, is used in the Mooney viscometer for factory control, whilst a modified form (shearing-cone) where shear rate is uniform throughout the rubber has proved a valuable research tool. *Compression.* In compression between parallel plates flow is complex, the shear rate varying throughout the specimen and with time of compression, so that fundamental constants can only be derived where rheological behaviour is simple. For factory control, the test is useful provided the materials tested do not show variable thixotropy, and because the compression principle makes possible a rapid simple test. Elastic recovery measurements are commonly made only on compression instruments, mainly for detecting incipient vulcanization, which strongly increases recovery.

A.

539.374

5143. A geometrical discussion of the slip line field in plane plastic flow. W. PRAGER. *K. Tekn. Högsk. Handl.*, *No.* 65, 25 *pp.* (1953).

The cycloid images of the slip lines in a stress plane (in which the Mohr circles for all points are drawn), and their images in a hodograph plane, are derived by purely geometrical arguments. Three types of

boundary condition are considered, and the problem of inverted extrusion is discussed in detail as an example of the construction of the slip line field from boundary conditions. J. G. OLDROYD

539.4 : 541.18.043 : 539.18 : 531.38

Some scientific applications of high speed rotation. *See Abstr.* 4627

539.4.019.1 : 666

5144. The dynamics of brittle tensile fractures in cylindrical glass rods. A. G. SMEKAL. *Acta phys. Austriaca*, **7**, *No.* 1, 110–22 (1953) *In German.*

A review of experimental work on the propagation of the fracture from the initial flaw. Ultrasonic tracers can be used to follow the break during the last microsecond. It is found that the velocity increases as the break proceeds, reaching a maximum "plateau" value (about half the velocity of shear waves) 1 mm from the starting point. By far the greater part of the time elapses before the plateau value is reached. During this stage thermal fluctuations are important and the detailed behaviour depends on the temperature and the rate of application of the load. R. O. DAVIES

539.501

5145. On the rigidity of elasto-viscous liquids. A. A. K. IBRAHIM. Letter in *J. appl. Phys.*, **24**, 364–5 (*March*, 1953).

An analogy is drawn between the constants associated with elasto-viscous liquids and those of a Kelvin solid. J. G. OLDROYD

539.67

5146. Explanation of the internal damping of solids by shear-viscosity and pressure-viscosity. H. O. KNESER AND K. VOELZ. *Ann. Phys.* [*Leipzig*] **11**, *No.* 4–7, 377–82 (1953) *In German.*

Some results of measurements point to the advisability of introducing a coefficient of the shear viscosity, independent of frequency, and a coefficient of volume viscosity. These coefficients might enable the damping to be compared for different forms of vibration. Volume viscosity for metals is probably zero. F. LACHMAN

PHYSICAL CHEMISTRY 541

541.1 : 532.7 : 533.7 : 539.11

5147. A treatise on physical chemistry. Volume 2: States of matter. Edited by H. S. TAYLOR AND S. GLASSTONE. 3rd Ed. *New York: D. Van Nostrand; London: Macmillan* (1951) v + 701 *pp.*

Review in *Nature* [*London*] **171**, 853 (*May* 16, 1953).

541.1 : 539.11

5148. An advanced treatise on physical chemistry. Volume 3. The properties of solids. J. R. PARTINGTON. *London: Longmans, Green and Co.* ix + 639 *pp.*

Review in *Brit. J. appl. Phys*, **4**, 126 (*April*, 1953). "Special attention has been devoted to crystal lattices and space groups, isomorphism, elastic properties, tensile strength, hardness, density, surface tension and viscometry as well as to the properties of solids in their association with heat reactions. The quantum theory of specific heat is also included."

PHASE EQUILIBRIUM . CHEMICAL REACTIONS 541.11/.12

541.123.5 : 531.724

Determination of surface area of a powder by the ion exchange method. *See Abstr.* 4629

541.124 : 536.7

5149. The theory of irreversible processes. I. H. G. REIK. *Ann. Phys.* [*Leipzig*] **11**, *No.* 4–7, 270–84 (1953) *In German.*

A new entropy s, a function of the thermodynamic co-ordinates, is defined by a relation between s and time. It agrees with the first law. Examples are given of its use in several processes not in equilibrium. C. TURNER

541.124 : 536.7

5150. The theory of irreversible processes. II. H. G. REIK. *Ann. Phys.* [*Leipzig*] **11**, *No.* 8, 407–19 (1953) *In German.*

The time axiom expressed in Pt I is applied to chemical gas reactions. For $t \to \infty$ the law of mass action results. This theory takes all degrees of freedom into account, therefore it can give the steric factor as a function of molecular constants and temperature. It is compared with the kinetic theory, and the "theory of absolute reaction velocity." The time axiom means for chemical reactions that the reaction velocity is dependent on transition probabilities. C. TURNER

541.124 : 536.7

5151. The theory of irreversible processes. III. H. G. REIK. *Ann. Phys.* [*Leipzig*] **11**, *No.* 8, 420–8 (1953) *In German.*

The Brönsted formula for chemical reactions in solution follows directly from the time axiom, without additional hypotheses. A short section deals with the influence of pressure and temperature on reaction velocity. C. TURNER

541.126 : 535.33

5152. Spectral and pressure observations of explosion phenomena. B. W. BULLOCK AND S. SILVERMAN. *J. Opt. Soc. Amer.*, **43**, 389–94 (*May*, 1953).

A Perkin-Elmer Model 83 Monochromator covering a spectral range from the ultraviolet to 5·5 μ is used for determining the light intensity as a function of time of an explosion in a bomb [see Abstr. 8603 (1950)]. The radiation entering the spectrometer is chopped to allow a.c. amplification of the detector output with provision to allow transmission as well as emission measurements. A frequency-modulated pressure gauge is used to determine the pressure

change in the bomb. Time resolution of the order of magnitude of 10^{-3} sec may be obtained for both spectral and pressure observations. Results for typical carbon-monoxide/oxygen explosions are shown. These preliminary results seem to indicate that there is equilibrium for approximately 0·02 sec after the flame front reaches the vessel wall. A.

541.126 : 537.58 : 539.566

5153. Reflection of microwaves by detonation phenomena. B. KOCH. *C.R. Acad. Sci.* [*Paris*] **236,** 661–3 (*Feb.* 9, 1953) *In French.*

The Doppler–Fizeau effect in the reflection of microwaves (wavelength = 23 cm) by the ionized gas in the rapidly-moving detonation front of 50/50 hexogen–TNT has been used to measure detonation velocity, the accuracy of individual measurements on sticks of explosive 1 m long and 5 cm dia. being 1–3%. A systematic error of +3·5% relative to other techniques is attributed to reflection from the laterally expanding detonation products. Measurement of the reflectivity of the ionized gas gives an estimate of the degree of ionization in the detonation front; for detonating hexogen–TNT an approx. estimate exceeds 10^{10} electrons/cm^3. A. SCHOFIELD

541.127

5154. On the physics of detonation of solid and liquid explosives. E. SÄNGER. *Z. Naturforsch.*, **8a,** 204–6 (*Feb.–March*, 1953) *In German.*

Essentially a translation of the author's recent paper in French [Abstr. 503 (1953)] but including a derivation of certain numerical constants merely quoted in the earlier version. A. SCHOFIELD

541.127

5155. Gaseous unimolecular reactions: theory of the effects of pressure and of vibrational degeneracy. N. B. SLATER. *Phil. Trans A,* **246,** *No.* 906, 57–80 (1953).

A theory which gave the high-pressure unimolecular reaction rate as $K_\infty = \nu \exp(-E_0/kT)$ is extended to find the decline of rate with pressure; the gas molecule is again a classical vibrating system which dissociates at a critical extension of an internal co-ordinate. The general rate K is found to be approximately

$$\frac{K}{K_\infty} = \frac{1}{\Gamma(\frac{1}{2}n + \frac{1}{2})} \int_0^\infty \frac{e^{-x} x^{\frac{1}{2}(n-1)} dx}{1 + x^{\frac{1}{2}(n-1)} \theta^{-1}}$$

where n is the effective number of normal modes of vibration; θ is proportional to $pT^{-\frac{1}{2}n}$, but depends also on the molecular structure and size. For $n \leqslant 13$, this integral is tabulated, and the pressures at which the rate declines from first order are estimated. The pressure tends to decrease as n increases; for $E_0/kT \sim 40$, it is estimated that only molecules with six or more atoms should show rates approaching K_∞ at normal pressures. The table of K/K_∞ is not carried as far as the "bimolecular" range, but a precise technique is developed for this region. The theory is compared with Kassel's classical theory of a molecule of s "oscillators." The low-pressure activation energy, and the shape of the curve of log K against log p, are similar in the two theories if $n = 2s - 1$; the absolute values of p for a given rate are also roughly comparable. Two results are proved, for the present severely classical model, concerning special cases. (i) A pair or triplet of degenerate modes with equal frequencies counts as one in assessing "n" for the general rate K. (ii) If the dissociation co-ordinate p relates atoms m_1, m_2, and m_1 is replaced by an isotope m_1^*, the high-pressure rate changes in the ratio $\sqrt{\{m_1(m_1^* + m_2)/m_1^*(m_1 + m_2)\}}$; for this, the internal potential energy V need not be quadratic, nor need q be isolated in V from other co-ordinates. A.

541.127

5156. Kinetics of decomposition of nitric oxide. F. KAUFMAN AND J. R. KELSO. Letter in *J. chem. Phys.*, **21,** 751 (*April*, 1953).

The catalytic influence of oxygen reported by Wise and Frech [Abstr. 3063 (1952)] in the decomposition of NO in a quartz reactor has not been reproduced under the same initial conditions. The reaction was studied by the amount of nitrogen formed, the entire contents of the quartz reactor being swept into a cold trap (immersed in liquid nitrogen) the pressure of nitrogen present being subsequently measured manometrically. The reaction mechanism proposed by Wise and Frech yields a dependence upon oxygen concentration in agreement with the suggested catalytic effect only under an approximation which the authors show to be incompatible with the results obtained from simple collision theory, according to which all dependence upon oxygen concentration in fact disappears. Possible sources of experimental error in the earlier work are suggested.

H. H. GREENWOOD

541.127

5157. Comments on the kinetics of thermal decomposition of nitric oxide. H. WISE AND M. F. FRECH. Letter in *J. chem. Phys.*, **21,** 752 (*April*, 1953).

Precautions have been taken to avoid the sources of experimental error suggested by Kaufman and Kelso (preceding abstract). Equally, errors may occur in the different experimental technique used by these authors for transferring the reaction products from the reactor to the cold trap and in the measurement of the non-condensable product. The different surface to volume ratios of the reaction vessels for the decomposition, predominantly heterogeneous at the temperature considered, could also account for the apparent disagreement. It is considered questionable whether adequate quantitative results can be obtained by simple collision theory which frequently gives specific reaction rates of unimolecular reactions of several orders of magnitude less than those observed experimentally. H. H. GREENWOOD

541.127 : 539.169

5158. Application of radioactive indicators to investigations on powder reactions in systems of silicates. U. BRUNE AND R. LINDNER. *Ark. Kemi,* **5,** *Paper* 26, 277–82 (1953) *In German.*

Pb^{212} and Ca^{45} have been used for the determination of the constants of powder reactions between SiO_2 and PbO or CaO, respectively. The constant for the reaction $PbO + SiO_2$ is $k = 10^{-7} \exp(-12\,800/RT)$ mol cm^{-2} sec^{-1}, and that for the reaction $CaO + SiO_2$ is $k = 2{\cdot}8 \times 10^{-2} \exp(-54\,000/RT)$ mol cm^{-2} sec^{-1}. F. LACHMAN

541.128 : 539.234

159. Catalysis on evaporated metal films. II. The fficiency of different metals for the reaction between ıethane and deuterium. C. KEMBALL. *Proc. Roy. ioc. A*, **217**, 376–89 (*May* 7, 1953).

For Pt I, see Abstr. 8525 (1952). The exchange eaction between methane and deuterium is followed n evaporated films of Rh, Pt, Pd and W. On all our catalysts there is evidence of two different nechanisms for the exchange as had been found n Ni catalysts (Kemball 1951): one produces CH_3D nd the other gives the compounds CH_2D_2, CHD_3 nd CD_4. The energies of activation, frequency actors and orders of reaction with respect to the pressures of the two gases for both mechanisms are letermined. The energies of activation on W are much lower than on the other metals, and this fact is attributed to the low activation energy for the adsorption of methane on W which occurs readily at 0°C. A section is devoted to a discussion of the effect of an inhibiting gas on the frequency factor of a catalytic reaction. It is shown that a relationship between the logarithm of the frequency factor and the energy of activation on different catalysts may be caused by a relationship between the entropy and heat of adsorption of the inhibiting gas on the catalysts. Fe films are found to have no catalytic activity for this reaction at temperatures up to 420°C. A.

ELECTROCHEMISTRY 541.13

541.133.1

5160. Diffusion and migration of $^{137}Cs^+$ in single crystals of NaCl. M. CHEMLA. *C.R. Acad. Sci.* [*Paris*] **236**, 484–6 (*Feb.* 2, 1953) *In French.*

See Abstr. 6840 (1952). The diffusion coefficient and the mobility of the radioactive ion $^{137}Cs^+$ in single NaCl crystals are measured: layers of CsCl are deposited on NaCl by sublimation, sealed and kept at temperatures between 55° and 75° during times varying between 1 and 70 hours. For the determination of the mobility a potential of 10 V between both sides of the crystals is applied. The activation energy is found to be 1·85 eV. The results verify Einstein's relation: this agreement has so far only occurred for autodiffusion of Na^+, and not for P^{32} and S^{35}. A. J. TAYLOR

541.135 : 539.23

Ionic current and film growth of thin oxide layers on aluminium. *See Abstr.* 5125

541.135 : 541.18

5161. The free energy of the double layer of a colloidal particle and the charging process. S. LEVINE. *Proc. Phys. Soc.* [*London*] *A*, **66**, 357–64 (*April*, 1953).

A detailed analysis is given of the alternative charging processes used by Verwey and Overbeek and the author to determine the free energy associated with the electric double layer of a colloidal particle. A general statistical proof of the equivalence of these methods is obtained. It is shown that the use of the different charging processes is equivalent to assuming an additional, hypothetical, thermodynamic variable to describe the colloidal system; this can be simply interpreted as an arbitrary "chemical" potential of the ions adsorbed on the particle surface. The expression for the free energy derived by Verwey and Overbeek is extended to apply to more general cases, and the treatment by these authors of the so-called chemical energy is clarified. A.

541.135 : 541.18

5162. Interaction of two parallel colloidal plates using a modified Poisson–Boltzmann equation. S. LEVINE. *Proc. Phys. Soc.* [*London*] *A*, **66**, 365–71 (*April*, 1953).

The application of the general formula for the free energy obtained in the preceding abstract is illustrated in the case of two parallel plates by introducing a number of corrections to the Poisson–Boltzmann equation and solving the resulting equation at small potentials. When the surface potential is 50 mV, the total correction to the interaction energy due to the deviations from the Poisson–Boltzmann equation is about 5% or less, except at small separations. A.

541.135 : 541.18

5163. Solution of a modified Poisson-Boltzmann equation for a single plane double layer. W. E. WILLIAMS. *Proc. Phys. Soc.* [*London*] *A*, **66**, 372–81 (*April*, 1953).

A method developed by Loeb to correct the Poisson–Boltzmann equation for the self-atmosphere effect of the ions is applied to the case of a charged plane surface immersed in a binary symmetrical electrolyte. The two limiting cases of a perfectly conducting and a perfectly insulating wall are treated. Numerical values of the correction to the average potential for various distances from the wall are obtained. This correction term is 5% near the wall for a conducting wall and 3% for an insulating one when the wall potential is 100 mV and is larger for higher potentials. A.

541.135.5 : 536.7

5164. Stationary states with minimum entropy production in electrochemical systems. P. VAN RYSSELBERGHE. *Bull. Acad. Roy. Belgique Cl. Sci.*, **38**, *No.* 11, 1060–7 (1952) *In French.*

Methods of the thermodynamics of irreversible processes are used for the case of two electrochemical half-reactions occurring simultaneously at the same electrode near the equilibrium point. Relates by linear relationships partial currents to the corresponding overpotentials. Applies Prigogine's theorem of stationary systems with minimum production of entropy to the systems referred to above. F. LACHMAN

541.136.22 : 621.352.1

5165. Effect of local action currents on the e.m.f. of the Weston Standard Cell. H. H. UHLIG. *J. Electrochem. Soc.*, **100**, 173–7 (*April*, 1953).

Local action currents on the surface of Cd–amalgam are shown to decrease slightly the measured e.m.f. of a Weston standard cell. The reversible e.m.f., E(therm.), is related to the observed steady-state e.m.f., E(obs.), and a function of local action currents $f(i)$ as follows: $E(\text{therm.}) = E(\text{obs.}) + f(i)$. Local action currents, calculated for a 10–13% Cd amalgam from hydrogen over-voltage data on Hg, are at least equal to $2{\cdot}1 \times 10^{-9}$ A/cm² corresponding to liberation of 0·008 ml H_2/cm²/year. Measure-

ments of anodic polarization of the amalgam show that this current affects the reversible e.m.f. not less than the order of 3×10^{-8} V, with the actual value being possibly larger by a factor of 100 times or more because of local action currents additional to those used in the calculation. The e.m.f. of the Weston cell is decreased whenever local action currents increase; by deposition, for example, of low over-voltage impurities from the electrolyte on the amalgam, and by presence of mercurous ions and dissolved oxygen plus other depolarizers. Factors increasing the observed e.m.f. include diffusion of low over-voltage impurities from the surface into the amalgam, reduction of oxygen and other depolarizers on ageing, and neutralization of electrolyte by the glass. A.

PHOTOCHEMISTRY . RADIATION CHEMISTRY 541.14/.15

541.14

5166. Effect of the intensity of irradiation on the mechanism of the photochemical reaction in silver halides with an admixture. O. STASIW. *Z. Phys.*, **134**, *No.* 1, 106–16 (1952) *In German.*

It has been found that, if Ag_2S is built into Ag halides, the S ions take the place of the Br ions, and the excess Ag is deposited in the lattice interstices; alternatively, Ag occupies a lattice site, causing a Br^- gap. A model for the mechanism of photochemical reaction is developed. A number of bands in the visible region have been detected as a result of irradiation with light. These bands which change into one another have been found to be associated with different complexes formed during irradiation. Their formation is discussed in relation to the intensity of irradiation. F. LACHMAN

541.14

5167. The photolysis of acetaldehyde. G. O. PRITCHARD, H. O. PRITCHARD AND A. F. TROTMAN-DICKENSON. Letter in *J. chem. Phys.*, **21**, 748 (*April*, 1953).

An Arrhenius plot is made for the reaction of methyl radicals with acetaldehyde from the experimental results derived from various sources. A consistency is observed for all cases except the results obtained by Dodd (abstract following) on the photolysis of acetaldehyde using the rotating sector technique. The discrepancy may be due to a chain propagating step in the photolysis which cannot be written as a single reaction, but as two reactions involving first the formation and subsequently the dissociation of the acetyl radical. It is concluded that little reliance can be placed upon rate constants determined by the rotating sector method when the precise mechanism is not well defined.

H. H. GREENWOOD

541.14

5168. The photolysis of acetaldehyde. R. E. DODD. Letter in *J. chem. Phys.*, **21**, 748–9 (*April*, 1953).

It is admitted that the evidence presented by Pritchard *et al.* (preceding abstract) suggests a greater complexity in the photolysis than previously supposed. Further possible causes of the discrepancy are briefly mentioned. H. H. GREENWOOD

541.14 : 535.247.4 : 621.389

5169. An apparatus for the photometric study of flash-initiated reactions. F. W. TROWSE. *J. sci. Instrum.*, **30**, 126–31 (*April*, 1953).

An apparatus is described in which a chemical reaction is initiated by a flash of light, and its progress followed by recording the light transmitted by the reacting system in a narrow region of the visible spectrum, using a lamp, filters, photomultiplier, amplifier, cathode-ray tube, and camera. The circuit arrangements which permit measurements to be made over times varying between 1 msec and 1 sec are described. A.

541.14 : 548.7

5170. Photochemical processes in alkali halide crystals at low temperatures. W. MARTIENSSEN. *Nachr. Akad. Wiss. Göttingen, math.-phys. Kl IIa, No.* 11, 111–16 (1952) *In German.*

Colour centre formation by irradiation of crystals with X-rays is studied at low temperatures. Absorption spectra are measured after irradiation and after warming the crystals or irradiation in their absorption bands. It is concluded that a pre-colour-centre complex is formed by the displacement of halogen ions from their lattice sites, the centres being called α-centres. On warming or suitable irradiation the ions return to their lattice sites or the complex dissociates to form a colour centre. G. F. J. GARLICK

541.14 : 548.7

5171. Generation of *F*-centers at low temperature. F. SEITZ. Letter in *Phys. Rev.*, **89**, 1299 (*March* 15, 1953).

A discussion of the formation and bleaching of the α-band in KBr at low temperatures reported by Martienssen (preceding abstract) and resulting indication of mechanism for *F*- and *V*-centre formation at such temperatures. The formation of the centres after X-ray absorption in the crystal depends on the production of a thermal "spike" which raises the local lattice temperature so that diffusion of paired vacancies away from each other may take place when they capture e^- or +ve holes. G. F. J. GARLICK

541.15

5172. The decomposition of solid potassium perchlorate by 50 kilovolt X rays. H. G. HEAL. *Canad. J. Chem.*, **31**, 91–102 (*Jan.*, 1953).

Potassium perchlorate crystals are decomposed by 50 kV X-rays. The main products of the primary decomposition are chlorate and chloride, but small amounts of unidentified oxidizing substances are also formed. The chlorate decomposes by a secondary reaction to chloride. These reactions are approximately of the first order. The average amount of X-ray energy absorbed by the salt per ClO_4^- ion decomposed is 19 ± 2 eV. A.

541.15

5173. The substitution reactions of bromine activated by neutron capture. II. Study of the formation of bromine derivatives of nitrobenzene and of methyl and ethyl benzoates. M. IVANOFF. *Bull. Soc. Chim. France*, **20**, 266–9 (*March*, 1953) *In French.*

For Pt I, see Abstr. 4697 (1952). The ratio of

o-, *m*-, *p*- isomers formed in the reactions of Br^{82} (34 hr) with nitrobenzene is 1·97/0·64/1 and with the benzoates, 20/2·5/1. Experimental details of the bromination methods used and of the procedures of separation of the reaction products are given. G. I. W. LLEWELYN

541.15

5174. Betatron irradiation of aqueous ferrous sulphate solutions. R. W. HUMMEL AND J. W. T. SPINKS. *Canad. J. Chem.*, **31**, 250–61 (*May*, 1953).

The oxidation of aerated aqueous solutions of ferrous ammonium sulphate has been studied using radium γ-rays and X-rays of 24·5 MeV peak energy from a betatron. The behaviour at high photon energies has been shown to be closely similar to that at lower photon energies. A.

541.15 : 539.27

Changes in $KMnO_4$ under electron bombardment in relation to its thermal decomposition. *See Abstr.* 5137

DISPERSIONS . COLLOIDS . ADSORPTION
541.18

541.18.043 : 539.4 : 539.18 : 531.38

Some scientific applications of high speed rotation. *See Abstr.* 4627

541.182.2

5175. Production of monodisperse liquid particles by electrical atomization. B. VONNEGUT AND R. L. NEUBAUER. *J. Colloid Sci.*, **7**, 616–22 (*Dec.*, 1952).

Streams of highly electrified uniform droplets about 0·1 mm in diameter can be produced by applying potentials of 5–10 kV a.c. or d.c. to liquids in small capillaries. Monodisperse aerosols having a particle radius of a micron or less can be formed if the capillary is positively charged and if liquids having low electrical conductivity are used. Aerosols formed in this way show the colours of higher-order Tyndall spectra. A.

541.183

5176. Interpretation of the thermodynamic properties of adsorbed argon at low surface coverages. L. E. DRAIN AND J. A. MORRISON. *Trans Faraday Soc.*, **48**, 316–26 (*April*, 1952).

Measurements of some thermodynamic properties of argon adsorbed on TiO_2 (rutile) at low surface coverages were described in an earlier paper [Abstr. 1286 (1952)]. It is shown here that these results may be interpreted satisfactorily on a model of localized adsorption on a heterogeneous surface without interactions. The distribution function for the energy of the adsorption sites has been obtained from the heat of adsorption data and has been used to calculate entropies and heat capacities of the adsorbed phase. The lack of information on the exact nature of the solid surface has prevented a detailed discussion of the source of the supposed heterogeneity. The configurational entropy is discussed in connection with recent work of Everett. A.

541.183

5177. On multilayer adsorption isotherms. O. THEIMER. *Trans Faraday Soc.*, **48**, 326–31 (*April*, 1952).

The molecular model underlying the B.E.T. formula is discussed and it is stressed that on the assumption that this theory is valid, the distribution of the adsorbing centres along the surface is restricted to arrangements excluding two-dimensional condensation. Under this condition the most probable surface structure allowing for the B.E.T. mechanism is found to be a loose arrangement of centres which are situated practically outside the range of mutual attraction. The adsorbed molecules form clusters round these centres. Further, the simplification implied in the B.E.T. theory, that the chemical potential μ_h of the molecules adsorbed in higher layers is equal to the chemical potential μ_L of molecules in the liquid adsorbate is dropped. Two different possibilities to generalize the condition $\mu_h = \mu_L$ are investigated which lead to good agreement with experiment. A.

541.183

5178. Discussion of the adsorption isotherms, measured by Kautsky, Gaubatz and Greiff, of gases on siloxene and bromsiloxene. I. E. DAUBACH. *Z. Naturforsch.*, **8a**, 186–90 (*Feb.–March*, 1953) *In German.*

The isotherms (measured by Kautsky *et al.*, 1930, 1938) of (*a*) CH_4, (*b*) C_2H_6, (*c*) C_3H_8, (*d*) CO_2 on siloxene and bromsiloxene have been examined. (*a*) and (*d*) fit a simple Langmuir equation, (*b*) and (*c*) require two Langmuir equations, one at lower, one at higher pressures. The results are interpreted in terms of interaction between the adsorbed molecules (*M*), in part arising from dipoles induced in *M* by the adsorbent. The adsorption is purely physical. S. J. GREGG

541.183 : 535.37

Luminescence and adsorption phenomena in some oxides and halides. *See Abstr.* 4721

541.183.1

5179. The orientational polarization of adsorbed polar molecules. J. A. SNELGROVE AND R. MCINTOSH. *Canad. J. Chem.*, **31**, 84–90 (*Jan.*, 1953).

The orientational polarization of a polar molecule adsorbed on a solid surface is deduced for two cases. First, the molecule oscillates in the plane of the surface about some equilibrium position. A zero temperature coefficient of the polarization is deduced. Second, the molecule may rotate freely in the plane within some given angle, but cannot incline to any greater extent from the equilibrium position under the influence of the field. The normal temperature coefficient is obtained with this model. The derivation of these formulae is based upon the procedures of Kurbatov who considered oscillation and rotation to be possible in three dimensions. The models employed here are considered preferable on the grounds that a physically adsorbed polyatomic molecule would presumably lie flat in the plane of the adsorbing surface. A.

541.183.1 : 537.226

5180. The dielectric behavior of vapors adsorbed on silica gel. J. A. SNELGROVE, H. GREENSPAN AND R. MCINTOSH. *Canad. J. Chem.*, **31**, 72–83 (*Jan.*, 1953).

Experiments to determine the dielectric constants of adsorbed butane, ethyl chloride and water on an activated silica at frequencies up to 3·7 Mc/s are reported. No Debye-type dispersion was observed for the polar adsorbates down to −30°c, the lowest temperature employed. Mixtures of ethyl chloride and water, and of butane and water, were also studied. The assumption that adsorption of ethyl chloride and water occurs with both adsorbates sharing two types of sites sufficed to explain the findings for this system. No explanation was apparent to account for the behaviour of the butane-water system. Formulae due to Kurbatov and to Snelgrove and McIntosh have been used to interpret the results obtained with polar adsorbates. On the assumption that the adsorbates have densities equivalent to those for the liquid state at the same temperature, it is concluded that adsorbed water undergoes oscillatory motion. The first quantities of ethyl chloride adsorbed behave as though the molecules may rotate freely within an angle of 98°. The ethyl chloride adsorbed nearer the saturation pressure shows oscillatory motion, as a negligible temperature coefficient of the molar polarization is observed. A.

541.183.5

5181. Adsorption on irradiated graphite. L. E. J. ROBERTS. *Atomic Energy Res. Establ.* [*Harwell*] *Mem.*, *C/M* 144, 3 *pp.* (1952).

The adsorption of argon at temperatures of −116°c, −139°c and −196°c, and the chemisorption of oxygen at 0°c, on irradiated and non-irradiated samples of the same graphite dust have been measured and compared. No large effect due to irradiation was observed. The dust was irradiated *in vacuo* in the N.R.X. pile to a total dose equivalent to 4×10^{19} n/cm² in B.E.P.O. A.

CHEMICAL STRUCTURE 541.2/.6

541.24

5182. Supplementary remarks on the determination of molecular weights by effusion method. W. MUND, J. FEYTEN AND P. HUYSKENS. *Bull. Acad. Roy. Belgique Cl. Sci.*, **38**, *No.* 8–9, 770–9 (1952) *In French.*

When using the effusiometric method with mixtures, it has been found that molecules, when traversing the orifice, do not exert any action on each other. Some effects attributed to absorption and causing considerable deviations of results have been studied. F. LACHMAN

541.57

5183. On the nature of the hydrogen bridge. R. T. SANDERSON. Letter in *J. chem. Phys.*, **21**, 571–2 (*March*, 1953).

It is shown that the hydrogen bridge in diborane and related electron deficient compounds occurs only when the hydrogen atoms of the bridge carry a partial negative charge. The increasing rate of disproportionation in the monohalodiboranes is paralleled by an increasing partial negative charge on these hydrogen atoms. H. H. GREENWOOD

CHEMICAL PROCESSES 542.9

542.934

5184. Ionic hydration and Stokes' law. A. L. LEVY. Letter in *J. chem. Phys.*, **21**, 566–7 (*March*, 1953).

Includes a table of hydration numbers for Li^+, Na^+, K^+, Cs^+ and Cl^-, obtained experimentally by the Washburn and Millard transference method, and of those calculated on the basis of the Mukherjee's water radius (2·06 Å) and of the Bernal–Fowler radius (1·38 Å); numbers calculated using the latter radius are in better agreement with experiment. F. LACHMAN

CHEMICAL ANALYSIS 543/545

543.712 : 621.317.39

5185. The electrical measurement of moisture in granular materials. D. J. MILLARD. *Brit. J. appl. Phys.*, **4**, 84–7 (*March*, 1953).

A study has been made of the electrical properties of wet granular materials. Variations of conductance and capacitance with moisture content are given for a capacitor containing samples of coal, sand, gravel, soil and glass beads. The effects of material packing on these variables have also been studied. The use of these data in designing an electrical moisture meter has been considered, and the performance of such a meter, used with a specially designed "fringe field" capacitor to monitor the moisture content of a stream of coal leaving a drying tower, is described. A.

544.83

5186. An X-ray microanalyzer camera. L. v. HÁMOS. *K. Tekn. Högsk. Avhandl.*, *No.* 80, 67 *pp.* (1953).

Focusing is achieved by reflecting X-rays from a NaCl plate plastically bent on to a cylindrical former. For most applications the surface of the object and the photographic film are coplanar and the axis of the cylinder lies in their plane. A separate image is formed for each wavelength emitted by the object. Microspectrographic analysis of fluorescent radiation from the object is therefore possible. The theory of the image formation is given and the construction and testing of the camera are described. Examples of applications are: measurement of thickness of a surface layer ~0·2 μ thick; microanalysis of alloys with specimens of volume $\sim 10^{-8}$ cm³; topographical analysis, or the mapping of concentration of a given element on a surface, e.g. or an ore. The method is compared with other X-ray imaging methods. A. R. STOKES

545.8 : 539.16.08

5187. The determination of uranium and thorium in ores. G. G. EICHHOLZ, J. W. HILBORN AND C. MCMAHON. *Canad. J. Phys.*, **31**, 613–28 (*May*, 1953).

The application of various physical methods to the assay of uranium and thorium in ores is discussed.

It is shown how it is possible to determine their uranium and thorium content by means of simultaneous measurement of their β and γ activities. Simple working equations are derived which permit this determination to be carried out irrespective of the equilibrium condition of the uranium in the sample. Suitable experimental equipment is described briefly and some typical experimental results are presented. A.

545.824

5188. Quantitative chemical analysis of the components of a mixture by the X-ray diffraction method. O. C. CORONA. *Rev. Mexicana Fis.*, **1**, 142–9 (*July*, 1952) *In Spanish.*

The theory of the method using the comparison of X-ray powder diffraction line intensities is given, and its application to NaCl–SiO_2 mixtures is described.

A. R. STOKES

545.827

5189. Measurement of deuterium oxide concentration in water samples by the mass spectrometer. H. W. WASHBURN, C. E. BERRY AND L. G. HALL. *Analyt. Chem.*, **25**, 130–4 (*Jan.*, 1953).

It was found that relative measurements in the range of normal deuterium concentration (0·015 atom %) could be made with good accuracy, provided that the formation of spurious *m/e* 19 ions (believed to be H_3O^+) could be reduced. A satisfactory reduction was accomplished by using an ion source in a strong magnetic field with about five times normal voltage applied to the ion-repelling electrode. For samples having D/(H + D) in the vicinity of 0·015 atom %, differences in concentration of 0·0006 atom % were reliably determined. In the range of 3 to 10% differences as small as 0·2 to 0·3% of the deuterium concentration were determined. In samples of nearly pure deuterium oxide, H/(H + D) could be determined within approximately ±0·002 atom %. A.

545.844

5190. Chromatographic separation of francium. M. PEREY AND J.-P. ADLOFF. *C.R. Acad. Sci.* [*Paris*] **236**, 1163–5 (*March* 16, 1953) *In French.*

Paper chromatography has been used for separating AcK from AcX and AcB, using the difference in solubilities of these Ac derivatives in $(NH_4)_2CO_3$.

F. LACHMAN

CRYSTALLOGRAPHY 548

548.19 : 548.733

5191. The use of X-ray diffraction cameras as recording optical goniometers. E. STANLEY. *Brit. J. appl. Phys.*, **4**, 88–90 (1953).

A method is described for the rough goniometry of small crystals using X-ray diffraction cameras. Visible light is used instead of X-rays and a photographic record of the external reflections is obtained by either the rotating-crystal or the Weissenberg technique. Each type of photograph is discussed in detail and examples are given showing how the goniometric data for all the faces may be rapidly determined with the aid of existing charts. The method requires crystals with linear dimensions not exceeding 1 or 2 mm and will reveal faces less than 0·01 mm². Practical details are given of the modifications of technique that are necessary and the precautions to be taken. A.

548.4

5192. The migration of a liquid inclusion in a crystal in the direction of a source of heat. G. G. LEMMLEĬN. *Dokl. Akad. Nauk SSSR*, **85**, *No.* 2, 325–8 (1952) *In Russian.*

Inclusions a few microns diameter were observed in crystals of $NaNO_3$ with a cine-microscope. At temperatures where the solubility is appreciable, capillariform inclusions break up into rows of spherical inclusions through transport of solute. The inclusions migrate up a thermal gradient because of the different solubilities at opposite sides.

A. L. MACKAY

548.5

5193. The preparation of uranium crystals. R. W. CAHN. *Atomic Energy Res. Establ.* [*Harwell*] *Rep. M/R* 744, 15 *pp.* (1951).

Applications of the strain-anneal and phase-change methods to the growth of alpha-uranium single crystals in two grades of uranium are described. While the strain-anneal method gave crystals which were structurally perfect, none were more than 2½ mm in diameter, probably owing to the occurrence of twinning during deformation. By the phase change method large, but imperfect, grains were obtained. An improved strain-anneal programme is suggested for future investigations. The report includes an extensive account of the determination of the orientations of alpha-uranium crystals from back reflection Laue X-ray photographs, and a short list of interplanar angles. A.

548.5

5194. A dislocation mechanism for the growth of hopper crystal faces and the growth of salol crystals from solution and from the melt. S. AMELINCKX. *Phil. Mag.*, **44**, 337–9 (*March*, 1953).

The mechanism, devised for the spirally terraced pits (hopper faces) observed on salol crystals [see Abstr. 2808 (1953)] is briefly outlined. An example of such a pit is shown and the step-heights measured by means of two-beam fringes are stated to range from 400–18 000 Å. Similar growth features have been observed on citric acid crystallized from alcohol, and on thymol. Salol crystals grown by slow solidification from the melt also exhibited both Frank type and terraced spirals. These are illustrated and very briefly discussed in relation to the theory of Burton, Cabrera and Frank [Abstr. 6560 (1951)]. S. WEINTROUB

548.5

5195. Crystallization of silicon from a floating liquid zone. P. H. KECK AND M. J. E. GOLAY. Letter in *Phys. Rev.*, **89**, 1297 (*March* 15, 1953).

The molten zone can be made to traverse the length of a rod of silicon held vertically because of

the high surface tension of the liquid phase, permitting crystallization from the melt without using a crucible.
W. BARDSLEY

548.5

5196. Growth and slip patterns on the surfaces of crystals of silver. A. J. FORTY AND F. C. FRANK. *Proc. Roy. Soc. A*, **217**, 262–70 (*April* 8, 1953).

Crystals of silver have been grown from the vapour by the technique already described for the preparation of crystals of the hexagonal metals. Monatomic growth steps on both cube and octahedral surfaces are readily visible after they have been "decorated" by the tarnish produced by "Plasticine." It is shown that dislocations in the silver crystals can be located by spiral growth patterns on the surfaces. In some cases the movement of a dislocation can be traced by the slip step raised in the growth surface. Many examples of deformation by unit slip, associated with the movement of dislocations, have been observed, although the crystals have not been stressed deliberately. A.

548.5

5197. On the epitaxis of crystals of anthraquinone and of urotropine on a cleavage plane of gypsum. L. ROYER. *C.R. Acad. Sci.* [*Paris*] **236**, 1430–2 (*April* 4, 1953) *In French.*

The orientations of anthraquinone crystals deposited from benzene solution on gypsum fall into three well defined groups relative to the (010) plane of gypsum. These are described in some detail and the rules governing the epitaxis are deduced and explained. Similarly for urotropine crystals from chloroform solution, but the measurements made so far are not accurate enough to distinguish between the rules of Willems [*Z. Kristallogr.*, **105**, 149–54 (1943)] and the author. S. WEINTROUB

548.5

5198. A special kind of growth structure in metal single crystals. F. BLAHA. Letter in *Nature* [*London*] **171**, 650–1 (*April* 11, 1953).

The growth boundaries of 99·99% pure Zn crystals, examined in natural relief by means of a stereomicroscope, and without etching, are illustrated and briefly described. The crystal wires of about 5 mm diameter were produced by a modified Czochralski–Gomperz method. On sudden removal of the wire from the surface of the melt a convex section at the end of the wire is produced which consists of small hexagonal units. Small raised spots, attributed to dendrites, within the hexagons, and parallel lines representing 0001 planes, were also visible. The growth structure is stated to be similar to those obtained by Buerger (1934). S. WEINTROUB

548.5

5199. Oriented overgrowth of crystals on talc and cadmium iodide. J. WILLEMS. *Experientia*, **9**, *No.* 5, 175–6 (1953) *In German.*

Oriented overgrowths of crystals of organic compounds on cleavage layers of talc and cadmium iodide and of NH_4I on talc are described. These oriented overgrowths are remarkable in view of the fact that the van der Waals forces between the layers of these substrate crystal lattices are only weak. The crystals of NH_4I oriented on talc have a square contour in contrast to the triangular crystals of NH_4I oriented on mica. A.

548.5 : 532.739.2

The solubility of silicon and germanium in gallium and indium. *See Abstr.* 4646

548.538

5200. An electron diffraction study of the reorientation of certain alkali halides deposited on mica and on mica surfaces covered by organic films. G. R. HOLZMAN AND K. H. MOORE. *J. Colloid Sci.*, **7**, 396–406 (*Aug.*, 1952).

In 1937, Bradley found that certain alkali halides deposited on organic films of considerable thickness covering freshly cleaved mica surfaces were capable of reorientation by mica when exposed to steam. The reorientation observed by Bradley resulted in tetrahedral forms visible optically. The present authors have investigated this phenomenon using electron diffraction, and have made a rather complete study of iodide layers deposited on mica, on organic films covering mica, and on organic films alone. Deposition was by evaporation in air, since iodide evaporated in vacuum penetrates thin organic films. In all cases, the reorientation was the same, and involved the presence of water vapour in limited quantity. Diffraction studies of iodide layers freshly deposited on mica show partial tetrahedral orientation; iodide layers on organic films show no such orientation whether the film is on mica or not. Exposure to water vapour produces complete tetrahedral orientation in iodide layers on bare or covered mica; none occurs on organic films alone. The reorientation may be due either to the propagation of mica surface forces through the intermediate film or to the diffusion of iodide through organic films which are not on mica, when water vapour is used. If diffusion is basic to the process, it is due to the mica. A.

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

5201. The construction of ball-and-spoke models of crystal structures. H. D. MEGAW. *Brit. J. appl. Phys.*, **4**, 107–10 (*April*, 1953).

Suggestions are made for simplifying the calculations required in the construction of models, and for rendering the models more easily reproducible. The requirements are (*a*) a drilling schedule in which angular co-ordinates are calculated with reference to directions fixed in space, and are recorded in an agreed notation applicable to any two-circle jig; (*b*) a "key diagram," a projection showing all included atoms marked with their heights and "code-numbers"; (*c*) a note referring to the original paper from which the data are taken. It may often be possible to add written instructions for assembling. Full instructions for a model of KH_9PO_4 are given as an example. A.

548.7

5202. The electronic structure of diamond. G. G. HALL. Letter in *Phys. Rev.*, **90**, 317 (*April* 15, 1953).

The equivalent orbital method as applied by the author to the electronic structure of diamond [Abstr. 4515 (1952)] has recently been referred to by

Herman [Abstr. 2057 (1953)]. The aim of the present letter is to make some additional explanatory remarks about the method, so as to prevent any misunderstanding which may possibly be caused by Herman's letter. P. T. LANDSBERG

548.7 : 536.424

5203. Some contributions to the question of crystallographic transition and crystal cracking. J. A. HEDVALL AND O. CARLANDER. *Ark. Kemi*, **4**, *Paper* 28, 389–400 (1952).

Substances which undergo a thermal transformation (1) always show a much increased reactivity at the change point and (2) may undergo cracking as a result of the change. A discussion of (1) concludes that it is due almost entirely to the state of instability during the transition and its facilitating the transport of matter from the interior of the lattice. The factors which determine the liability to cracking are discussed and an account is given of several experimental attempts to detect transformation-produced cracks in quartz. A. D. LE CLAIRE

548.7 : 538.22

Magnetic susceptibility of colored potassium chloride from 1°K to 300°K. *See Abstr.* 4903

548.7 : 541.14

Photochemical increases in alkali halide crystals at low temperatures. *See Abstr.* 5170

548.7 : 541.14

Generation of F-centers at low temperature. *See Abstr.* 5171

548.73/.74 : 539.26/.27

X-ray and electron investigation of materials. *See Abstr.* 5128–38

548.733

5204. A new camera for direct recording of the reciprocal lattice. J. M. TORROJA, J. L. AMORÓS AND E. P. DÍAZ. *Rev. Cienc. apl.*, **6**, 325–30 (*July–Aug.*, 1952) *In Spanish.*

Describes the construction of a camera based on the principle of de Jong and Bouman (1938). A. R. STOKES

548.733

5205. Description of a camera for taking Debye–Scherrer photographs of specimens at very low temperatures. L. BOUTTIER AND J. M. DUNOYER. *Bull. Soc. Franç. Minéral. Crist.*, **76**, 79–85 (*Jan.–March*, 1953) *In French.*

The construction is described. The specimen is cooled by a stream of air which is in turn cooled by liquid nitrogen. A thermocouple shows the temperature of the specimen. Temperatures between −155°C and +200°C may be obtained. A. R. STOKES

548.733

5206. Low-angle X-ray diffraction with long wavelengths. B. HENKE AND J. W. M. DUMOND. Letter in *Phys. Rev.*, **89**, 1300 (*March* 15, 1953).

Describes a diffraction unit (including a special X-ray tube) for use with X-ray wavelengths up to about 50 Å and in which a point focus image of the source is formed by a nearly cylindrical totally reflecting mirror of glass. A large solid angle of radiation is used and the mirror is constructed so as to cut off all radiation harder than that desired. A. E. DE BARR

548.733

5207. The design and operation of a precision Geiger–Müller counter X-ray diffraction spectrometer. R. A. COYLE, K. F. HALE AND C. WAINWRIGHT. *J. sci. Instrum.*, **30**, 151–5 (*May*, 1953).

The design and construction of a G.M. spectrometer circle suitable for a wide variety of applications and of mechanical accuracy comparable with that of a precision powder camera is described. Ancillary equipment for the study of integrated intensities from flat powder specimens has been constructed, utilizing monitored monochromatic radiation and making provision for automatic operation. Discussion of G.M. counter performance necessary to achieve a standard deviation of intensity measurements of about 0·5% is included with some results demonstrating the attainment of this accuracy. A.

548.734.3

5208. A new cause of spottiness of X-ray powder diffraction lines. A. BOULLÉ AND M. MARIÉE. *C.R. Acad. Sci.* [*Paris*] **236**, 1179–82 (*March* 16, 1953) *In French.*

Powder lines of some samples of recrystallized KCl show more spottiness than those of sylvine of the same grain size; this is attributed to the formation of agglomerates of crystals with the same orientation. A. R. STOKES

548.735.4 : 535.42

5209. Apparatus used in the development of optical-diffraction methods for the solution of problems in X-ray analysis. W. HUGHES AND C. A. TAYLOR. *J. sci. Instrum.*, **30**, 105–9 (*April*, 1953).

The methods described involve the observation of the diffraction patterns of holes punched in thin card to represent atomic arrangements. Details are given of the instrument that is used to observe these patterns and also of the pantograph-punch that is used to prepare the cards. Several examples of diffraction patterns are given; some illustrate the performance of the instrument with lenses of various optical qualities and others illustrate the use of the instrument in the teaching of physical optics. A.

548.735.4

5210. On the principles of the direct determination of the parameters of crystalline organization. J. MERING AND J. LONGUET-ESCARD. *C.R. Acad. Sci.* [*Paris*] **236**, 1501–3 (*April* 13), 1577–9 (*April* 20, 1953) *In French.*

The Fourier transform of quantities obtained from the intensities of X-ray diffraction can be used to show the distribution in space of cells of a distorted or disordered crystal. A. R. STOKES

548.735.4

5211. Lattice sums: the validity of Evjen's method. I. D. C. GURNEY. Letter in *Phys. Rev.*, **90**, 317–18 (*April* 15, 1953).

Evjen's method [*Phys. Rev.*, **39**, 675–87 (Feb. 15, 1932)] of evaluating the Madelung constant for the CsCl lattice leads to a paradox which is resolved if one considers the surface charges left from the grouping of charges chosen. A. R. STOKES

548.735.46

5212. Cylindrical Patterson syntheses for the investigation of chain directions in X-ray crystal analysis. A. D. BOOTH. *Trans Faraday Soc.*, **48**, 197–200 (*March*, 1952).

It has been suggested by Bragg that a variant of the

standard Patterson synthesis is required which will display, along a line, the integrated contents of a cylinder having that line as axis. Syntheses suitable for this purpose are developed and alternative forms are given to permit of easy computation. A.

548.736.3

5213. The dependence of the quantitative composition of a phase on the ratio of the atomic radii in one class of intermetallic phases. P. I. KRIPYAKEVICH. *Dokl. Akad. Nauk SSSR*, **85**, *No.* 2, 321–4 (1952) *In Russian.*

In the class of binary intermetallic compounds where the smaller atoms have a tendency to covalency and lie on a hexagonal net, a correlation is found between the radius ratio, the phase composition and the type of structure. Structure types examined are: MgZn, W_2Fe_7, $MgZn_2$, $MgCu_2$, $CuZn_5$, $MgZn_{11}$ and $NaZn_{13}$. A. L. MACKAY

548.736.3

5214. The crystal parameters of rutile and anatase. C. LEGRAND AND J. DELVILLE. *C.R. Acad. Sci.* [*Paris*] **233**, 944–6 (*March* 2, 1953) *In French.*

For rutile $a = 4{\cdot}584$ Å, $c = 2{\cdot}953$ Å; for anatase, $a = 3{\cdot}777$ Å, $c = 9{\cdot}501$ Å; all to 5 parts in 10^4. These are compared with previous determinations, and the parameter fixing the positions of the oxygen atoms is given for both minerals. A. R. STOKES

548.736.3

5215. [X-ray] study of some chromium borides. F. BERTAUT AND P. BLUM. *C.R. Acad. Sci.* [*Paris*] **236**, 1055–6 (*March* 9, 1953) *In French.*

Lattice parameters and descriptions of structures are given for Cr_4B, Cr_2B and Cr_5B_3. A. R. STOKES

548.736.3

5216. The structure of silicon monoxide. G. JACOBS. *C.R. Acad. Sci.* [*Paris*] **236**, 1369–71 (*March* 30, 1953) *In French.*

Conflicting structures given in the literature are attributed to the transformation $2SiO \rightarrow Si + SiO_2$ at high temperatures. A. R. STOKES

548.736.4

5217. Crystal structure of the ternary phase Cu_4MgSn. E. I. GLADYŠHEVSKIĬ, P. I. KRIPYAKEVICH AND M. YU. TESLYUK. *Dokl. Akad. Nauk SSSR*, **85**, *No.* 1, 81–4 (1952) *In Russian.*

548.736.5

5218. Crystal structure of soda with seven molecules of water. P. HEMILY. *C.R. Acad. Sci.* [*Paris*] **236**, 1579–81 (*April* 20, 1953) *In French.*

Monoclinic cell contains four structure units. Atomic co-ordinates and diagrams of structure are given. A. R. STOKES

548.736.

5219. The structure of the hexaniobate ion in $7\,Na_2O.6\,Nb_2O_5.32\,H_2O$. I. LINDQVIST. *Ark. Kemi*, **5**, *Paper* 22, 247–50 (1953).

Orthorhombic, *Pmnn* (*m* by absence of piezoelectricity), $a = 10{\cdot}01$, $b = 12{\cdot}13$, $c = 12{\cdot}61$ Å, $Z = 1$, Nb positions from Patterson synthesis, O positions from geometrical considerations and confirmed by peaks in the syntheses, Na and H_2O not placed. The structure contains $Nb_6O_{19}^{8-}$ ions, each in the form of an octahedron of O octahedra sharing edges. Rotation, Weissenberg and powder photographs. A. J. C. WILSON

548.736.

5220. The crystal structure of $U_6O_4(OH)_4(SO_4)_6$. G. LUNDGREN. *Ark. Kemi*, **5**, *Paper* 34, 349–63 (1953).

Tetragonal, $I4/m$, $a = 10{\cdot}741 \pm 5$, $c = 10{\cdot}377 \pm 5$ Å, $Z = 2$, U positions from Patterson syntheses, other atoms by geometrical considerations. The proposed structure consists of SO_4 and $U_6O_4(OH)_4$ groups. Laue, rotation, Weissenberg and powder photographs. A. J. C. WILSON

548.736.6

5221. Randomly stacked layers in clay minerals. D. M. C. MACEWAN. Letter in *Nature* [*London*] **171**, 616–17 (*April* 4, 1953).

The sequence of 10 Å and 12·4 Å interlayer spacings in mica is investigated by Méring's Fourier-transform method [Abstr. 6159 (1950)]. A. R. STOKES

548.74

5222. Determination of the shape of thin single crystal lamellae with the help of apparent structures arising from crystal lattice reflections. O. RANG. *Optik*, **10**, *No.* 1–3, 90–106 (1953) *In German.*

By dark field electron microscopy and electron diffraction of a bent crystal sheet the geometrical position of the crystals responsible for the diffraction effects is worked out. The nature of the bending can be determined, also the thickness of the crystal in the direction of the beam. J. THEWLIS

548.74 : 537.533.73

Electron diffraction in lead iodide with a convergent beam. *See Abstr.* 4856

GEOPHYSICS 55

550.311

5223. Comments on planetary convection as applied to the earth. H. C. UREY. Letter in *Phil. Mag.*, **44**, 227–30 (*Feb.*, 1953).

Chandrasekhar's interpretation of Vening Meinesz' proposals (1951) regarding the role played by convection in the earth's mantle is considered from the point of view of the evolution of terrestrial land and sea masses. It is demonstrated that, if single-cell convection is responsible for the land formation, then the earth must have been formed in a highly viscous condition, the core being evolved in an appreciable fraction of the total time of formation. Vening Meinesz' explanation of the first-order spherical harmonic as due to the escape of the moon from the earth is discounted. D. R. BARBER

550.341

5224. The characteristic data of electromagnetic seismographs. G. GRENET. *Ann. Géophys.*, **8**, *No.* 3, 328–32 (1952) *In French.*

It is shown that with the use of only two families of curves it is possible to determine all characteristic data for seismic instruments which combine a pendulum with one galvanometer. Some of the results are generalized for the study of arrangements which utilize several galvanometers, including those used for registration. A. BEER

550.341.2 : 525.35

5225. Fluctuations in the earth's rotation and seismic activity. F. H. VAN DEN DUNGEN, J. F. COX AND J. VAN MIEGHEM. *Bull. Acad. Roy. Belgique Cl. Sci.*, **38**, *No.* 6, 607–11 (1952) *In French.*

It appears that earthquakes are more frequent during the periods when the rate of the "earth-clock" changes its sign. The observational material used covers the period 1830–1950. A. BEER

550.342

5226. The origins and nature of microseisms in the frequency range 4 to 100 c/s. C. D. V. WILSON. *Proc. Roy. Soc. A*, **217**, 176–88 (*April* 8, 1953).

Microseisms in the frequency band 4 to 100 c/s, commonly encountered in seismic prospecting, have been investigated in various parts of England, urban and rural. A diurnal variation in background level, indicating man-made sources, was found everywhere within 2 miles of a major road or community. The main sources were found to be traffic, heavy machinery, aircraft, wind and rain, with traffic prevailing. In rural areas at night-time a steady background of about 10^{-6} cm/sec r.m.s. particle velocity was found, with occasional superimposed activity lasting 4 to 30 sec. The latter has been shown mostly to be local and of geophysical origin, the precise nature of which is unknown. Various possible causes are discussed, both of this and of the minimum background. A.

550.342

5227. An analysis of the vibrations emitted by some man-made sources of microseisms. C. D. V. WILSON. *Proc. Roy. Soc. A*, **217**, 188–202 (*April* 8, 1953).

Study of the vibrations from traffic and machinery shows that most of the man-made microseisms are in the 4 to 10 c/s range, at least near Cambridge. Examination of traffic microseisms shows that surface waves predominate at 200 yards or more from the source. Their frequency depends more on geological conditions than separation of source and observer. Microseisms from a waterworks pump were recorded up to 4 miles away, and consisted of bodily waves of 15 to 42 c/s frequency, and surface waves of 7 to 10 c/s which predominated at distances greater than ½ mile from the pump. It is concluded that the bulk of microseisms are surface waves from traffic and machinery, but their attenuation renders them insignificant in most cases at a distance of 2 miles. A.

550.373

5228. Exceptional cases of electromagnetic interpretation problem. A. T. PRICE AND L. B. SLICHTER. *Proc. Roy. Soc. A*, **216**, 434–5 (*Feb.* 10, 1953).

This note points out that the method proposed by Slichter [Abstr. 8949 (1952)], for determining the variation of the electrical properties of the earth with depth by electromagnetic induction, will fail for certain special distributions of the exciting magnetic field, and examines mathematically why this is so.

A. T. PRICE

550.38

5229. Dispersion on a sphere. R. FISHER. *Proc. Roy. Soc. A*, **217**, 295–305 (*May* 7, 1953).

Any topological framework requires the development of a theory of errors of characteristic and appropriate mathematical form. The paper develops a form of theory which appears to be appropriate to measurements of position on a sphere. The primary problems of estimation as applied to the true direction, and the precision of observations, are discussed in the subcases which arise. The simultaneous distribution of the amplitude and direction of the vector sum of a number of random unit vectors of given precision, is demonstrated. From this is derived the test of significance appropriate to a worker whose knowledge of precision lies entirely in the internal evidence of the sample. This is the analogue of "Student's" test in the Gaussian theory of errors. The general formulae obtained are illustrated using measurements of the direction of remanent magnetization in the directly and inversely magnetized lava flows obtained in Iceland by Mr. J. Hospers. A.

550.835

5230. Description of a simplified apparatus for gamma radiosondage used for mine survey. J. BERBEZIER AND C. LALLEMENT. *Ann. Géophys.*, **8**, *No.* 3, 314–15 (1952) *In French.*

Details are given of two equipments designed for use in mines comprising a Geiger counter on the end of a suitable cable and a simple integrating detector. One form of apparatus is suitable for use in vertical shafts and the other in horizontal shafts.

J. M. HOUGH

550.835

5231. Interpretation and utilization of the measurement of the penetrating radiation of rocks on the surface. A. HÉE AND R. LECOLAZET. *Ann. Géophys.*, **8**, *No.* 3, 316–19 (1952) *In French.*

Eve's formula is used to calculate the constant of the rock as a source of radiation when the disturbing effects of cosmic rays and atmospheric radioactivity have been eliminated. Methods of making these corrections for two different types of counter are given and also the effect of the local topography is discussed. Two samples of rock, whose behaviour was known, were used to test the equipment and it was shown to be satisfactory. The authors suggest that the method is suitable for the determination of thorium when the potassium content is known by chemical analysis and the uranium content by the radon method. An example of this is given and it is shown that the accuracy is about 33%. J. M. HOUGH

ATMOSPHERE . METEOROLOGY 551.5

551.510.3

5232. A comparative analysis of atmospheric densities from meteor decelerations observed in Massachusetts and New Mexico. L. G. JACCHIA. *Harvard Coll. Obs. tech. Rep., No.* 10, 37 *pp.* (1952).

Velocities, decelerations and integrated luminosities have been determined from pairs of photographic records for 46 Massachusetts and 73 New Mexico meteors. Atmospheric densities, computed from the New Mexico data using the basic relation, $\rho = -Km^{1/3}v^{-2}dv/dt$ [see *Harvard Coll. Obs. tech. Rep.*, No. 2 (1948)] agree closely with values derived from V-2 rocket measures; although the residuals from the rocket curve are strongly dependent on velocity. However, the introduction of an empirical scale-factor corrects velocity-free densities to the rocket density-profile; and these corrected values show only a slight seasonal effect. The densities derived from the Massachusetts record correlate well with the New Mexico data up to 75 km. Above this height the former are consistently higher. The seasonal effect is more than twice as large for the Massachusetts observations as for New Mexico which, in part, is accounted for by the poor distribution of the former series with regard to season. D. R. BARBER

551.510.41

5233. On the amount of atmospheric ozone and its relation to meteorological conditions. K. LANGLO. *Geofys. Publ.*, **18,** *No.* 6, 42 *pp.* (1952).

The available observational data are summarized and a description given of the optical method of measuring the total amount of atmospheric O_3. Sources of error are discussed. Simultaneous measurements allow estimates to be made of the horizontal distribution of O_3, but scarcely give an exact value of its total amount. Observations support the idea that the variations from year to year in the total amount are chiefly dominated by meteorological conditions. Horizontal transport (advection) of the O_3 due to the general circulation of the atmosphere is important for seasonal changes in the amount. The main effect of the general circulation in the O_3 incline region during the late spring and summer is to reduce the total amount of O_3 in middle and high latitudes. The variation of wind speed with height in the O_3 incline region may by advection produce overlapping of accumulated O_3 layers. The highest O_3 values during the passage of a polar front cyclone occur near the centre of its tropopause trough. Most of the day to day variations in O_3 are probably due to vertical air movement in the O_3 incline region. Mother of pearl clouds are possibly formed by a combination of (1) upward motion of a semi-stationary wave in the contour lines of a stratospheric pressure surface provided the wave is suitably aligned to a mountain ridge, (2) upward motion connected to a Föhn wave caused by the mountain ridge, (3) existence of enough water vapour to form clouds. It is considered that the upper part of the O_3 (equilibrium) layer contains only a small part ($\sim$0·017 cm) of the total O_3 and is probably approximately independent of latitude and season at least from equator to about 65°N. The layer 35–20 km normally contains the greatest O_3 concentration and is regarded as a zone of transition. The non-equilibrium zone, below 20 km, has changes in accumulated O_3 which can explain most of the day to day changes. The maximum and minimum of the annual curve and the distribution with latitude of O_3 are explained as the result of seasonal changes in the vertical air motion and in the advection of air with different O_3 content. The changes from year to year in the annual amount of O_3 are supposed due to irregular variations of the general circulation. R. S. READ

551.510.41 : 523.77

The absorption due to carbon monoxide in the infra-red solar spectrum. *See Abstr.* 4569

551.510.5355

5234. The continuous layer formation in the atmosphere under the influence of solar radiation. H. K. KALLMANN. Letter in *Phys. Rev.*, **90,** 153 (*April* 1, 1953).

Previous theories of the production of an ionized region consider discontinuous layer formation: (i) Chapman parabolic layer (constant molecular weight, constant temp.), and (ii) Nicolet narrow layer (constant molecular weight, temp. increase with height). A new theory has been developed which better represents the physical picture: (iii) continuous layer formation from the bottom of the *E*-layer (80 km) to the *F*1 maximum, assuming temp. increase and molecular weight decrease with height. Curves are given to show the effect of medium and large solar disturbances on the layer formation (iii) for average noon conditions. G. M. BROWN

551.510.535

5235. Influence of the solar eclipse of February 25, 1952, on the ionospheric *E* region in equatorial Africa. S. ESTRABAUD. *C.R. Acad. Sci.* [*Paris*] **236,** 833–5 (*Feb.* 23, 1953) *In French.*

Results of ionospheric soundings made at Bangui (4° 22′N, 18° 36′E). While the critical frequency of the *E*2 region decreased markedly at the onset of the eclipse, the precise time at which the effects of the eclipse commenced in the *E*1 layer is certainly between 5 and 20 min before first contact. This may be interpreted by postulating the existence of two active regions on the sun. The relation between the solar zenith angle (χ) and electron density (N) may be written $N^{1\cdot6}\cos^{-1}\chi = \text{const.}$ and three different interpretations of this are considered. G. M. BROWN

551.510.535

5236. Formation of the *D*-layer. K. WATANABE, F. MARMO AND E. C. Y. INN. Letter in *Phys. Rev.*, **90,** 155 (*April* 1, 1953).

Recent measurements of absorption cross-sections indicate that the most likely process responsible for the formation of the *D*-layer is photo-ionization of nitric oxide (λ1100–1300) rather than of molecular oxygen (λ900–1000). The ionization cross-section of NO is about 25 times larger than the value estimated by Bates [Abstr. 3569 (1950)]: ionization by Lyman α is particularly important. A table is given of absorption cross-sections of various atmospheric gases at Lyman α. G. M. BROWN

551.510.535 : 538.566.3

Radio-wave propagation in the ionosphere. *See Abstr.* 4935

551.510.535 : 551.557

5237. Ionospheric wind systems and electron concentrations of the *F* layer. D. G. YERG. *J. Meteorol.*, , 244–50 (*Aug.*, 1951).

Values of the kinematic viscosity η/ρ were calculated for 0, 10, 50, 100, 150, 200, 250 and 300 km altitude, and the values agree in the lower levels with similar data based on Sutherland's formula (depending on temperature). Extrapolation of data in layer thickness versus mean free path indicates that beyond 00 km viscous effects decrease, so that a maximum of viscous action occurs below that level (perhaps at 00 km). A model is proposed for circulation in the stratosphere based on observed lapse rates, calculated winds and this study of viscous stresses. Slipping is thought to occur about 200 km, yielding east winds at all latitudes. Effects on ion concentration explain observed longitudinal variations in F_2 layer.

METEOROLOGICAL ABSTRACTS

551.513

5238. World-wide oscillations in the earth's atmosphere. M. V WILKES. *Quart. J. Roy. Meteorol. Soc.*, **78**, 321–36 (*July*, 1952).

The periodic motions of the atmosphere as a single mechanical system considered include all particles from the equator to the poles, and from the surface to the ionosphere, and caused by the sun and moon. The moon causes a semi-diurnal tide decreasing in amplitude from the equator to the pole and the effect is gravitational only. For the sun there are gravitational and thermal effects. The effect of the colder layers near the tropopause and at a height of about 80 km acting as barriers are dealt with. Oscillations in the region between the barrier and the ground are damped because of leakage through the barrier. Theoretical considerations show that the oscillations are similar to the solar semi-diurnal oscillation with regions of high and low pressure rotating with the sun and with an amplitude decreasing uniformly and symmetrically from the equator to the pole. A period near to 12 hours is possible with a barrier near a height of 70–90 km. The pulses from the Krakatoa explosion showed that most energy went into the pulse trapped by the lower barrier. Resonance is necessary to explain why the phase and amplitude of the oscillation vary so uniformly over the earth's surface and in particular why it is symmetrical about the equator. The relative magnitude of the gravitational and thermal effects were calculated on the basis of observed semi-diurnal temperature variation over the surface of the earth. It is shown that the dynamical theory of atmospheric oscillations in conjunction with knowledge of the ionosphere explains the quiet day magnetic variation. Finally the effects of lunar tide in the ionosphere and tidal motion in the *F*-region are considered and it is considered that the dynamical theory applicable to the lower part of the atmosphere has no relevance to oscillations in the *F*-region. R. S. READ

551.513

5239. The criterion of atmospheric turbulence. W. C. SWINBANK; L. F. RICHARDSON. Letters in *Quart. J. Roy. Meteorol. Soc.*, **78**, 420–5 (*July*, 1952).

Making certain assumptions L. F. Richardson (1920) extended Reynolds' investigations of the criterion for the change of turbulence of an incompressible fluid to the case of the atmosphere. He obtained the criterion that the kinetic energy of atmospheric turbulence will increase if the rate of generation through shearing stresses exceeds the rate of degeneration through stability and vice versa. This led to the use in atmospheric turbulence of the so-called Richardson number represented by $(g/T)(\partial T/\partial z + \Gamma)/(\partial\bar{v}/\partial z)^2$. The validity of Richardson's conclusions are questioned. In a reply Richardson refers to later papers in 1925 and 1930 where it is shown that the law of diffusion may be altogether different for different choices of the mean. The criticisms by Swinbank are dealt with point by point. R. S. READ

551.513

5240. Influence of Coriolis force on atmospheric motion. P. DEDECKER. *Bull. Acad. Roy. Belgique Cl. Sci.*, **38**, *No.* 6, 637–41 (1952). Also in *Publ. Inst. Roy. Météorol. Belgique*, *No.* 6, 637–42 (1952) *In French.*

The Coriolis force acting on a moving mass of air is calculated with the help of exact equations of motion. The result is compared with a recent paper by C. G. Rossby where approximate equations were used. R. S. READ

551.513 : 523.677 : 536.25

The instability of a layer of fluid heated below and subject to Coriolis forces. *See Abstr.* 4762

551.521.13

5241. The solar constant. H. G. HOUGHTON. *J. Meteorol.*, **8**, 270 (*Aug.*, 1951).

Recomputation of the solar constant gives a value of 1·952 ly/min (g cal cm^{-2} min^{-1}) which is not far from the value of 1·946 based on Smithsonian data for 1924–1939. The latter value was considered to be 2·4% too high due to scale error, but two other corrections (for ultraviolet and infrared radiation) nearly balance the scale error. Thus 3 errors seem to cancel out, leaving 1·95 as very close to "true" solar constant. METEOROLOGICAL ABSTRACTS

551.521.3 : 551.57

5242. Relation between the absolute atmospheric humidity and the coefficient of transmission of solar radiation according to the measurements made at the Observatory of Rome from 1935 to 1950. M. A. GIANNUZZI. *R.C. Accad. Naz. Lincei*, **13**, 380–5 (*Dec.*, 1952) *In Italian.*

Monthly and ten-day averages of humidity at Mount Mario are given, and these, together with corresponding records of the absorption of solar radiation, confirm the correlation between these two quantities already noted by Cimino [Abstr. 3608 (1949)]. R. A. NEWING

551.574.7 : 551.578.4

5243. Temperatures of co-existence of ice crystals and drops of salt solution in the atmosphere. L. DUFOUR AND R. DEFAY. *Publ. Inst. Roy. Météorol. Belgique*, *No.* 5, 3–19 (1952) *In French.*

Formulae were established which provide the

temperature for the co-existence of an ice crystal and a drop of salt solution as a function of their respective radii, the atmospheric pressure and strength of solution. These formulae allow one to follow the evolution of a drop containing a fixed amount of the non-volatile dissolved body. Temperatures for the co-existence of drop/air/crystal at atmospheric pressure were calculated. This temperature varies appreciably depending upon whether the crystal is outside or in the drop. In the latter case the differences between the calculated and ordinary triple point are much less than for the former. For a crystal in contact with a drop, it is concluded that this kind of crystallization should be more frequent than solidification direct from the vapour upon a crystalline nucleus separated from the drop. R. S. READ

551.575.1 : 539.27

5244. Electron-microscope study of fog nuclei. D. KUROIWA. *J. Meteorol.*, **8**, 157–60 (*June*, 1951).

The application of electron microscopy to the study of fog nuclei is described. Microphotographs of fog nuclei are presented. It is concluded that sea fog nuclei contain both hygroscopic and non-hygroscopic nuclei. METEOROLOGICAL ABSTRACTS

551.578.41 : 539.27

5245. Electron-microscope study of snow-crystal nuclei. M. KUMANI. *J. Meteorol.*, **8**, 151–86 (*June*, 1951).

The method of preparing nuclei specimens of snow crystals for study with the electron microscope is described. Microphotographs of snow nuclei crystals are given and the structure of the nuclei is analysed. A mechanism for snow crystal growth is suggested.

METEOROLOGICAL ABSTRACTS

551.578.41 : 539.27

5246. An electron microscope study of snow crystal nuclei. U. NAKAYA. *J. Glaciol.*, **2**, 176–80 (*April*, 1953).

See also preceding abstract. Snow crystals were received on the collodion film of the holder of an electron microscope, and made to sublimate without melting. These specimens were investigated under an electron microscope. One solid nucleus was always observed in the central portion of a snow crystal. These centre nuclei were of sizes between 0·5 and 8 μ. Most of them were presumed to be kaolin, clay or carbon particles; some were considered to be micro-organisms. In the other parts of snow crystals numerous smaller nuclei were observed, whose dimensions were of the order of those of condensation nuclei. These condensation nuclei were found to be of two kinds, the larger ones most frequently having a diameter of about 0·15 μ, the smaller ones of about 0·05 μ. A new theory was proposed from the data of the electron microscopic studies and those of the conditions of formation of snow crystals. In this theory it is proposed that minute water droplets of 1 μ or so play an important role in the process of snow crystal growth. A.

551.593.55 : 551.524.7

5247. Temperature of the atmosphere and twilight discontinuities. R. GRANDMONTAGNE. *C.R. Acad. Sci. [Paris]* **236**, 1066–7 (*March* 9, 1953) *In French.*

Recent determinations of upper-atmosphere temperatures by means of rockets appear to confirm the author's suggestion (1942) that a max. temperature at 50 km (upper ozone limit) is a possible cause of the observed discontinuity in the decrement curve of zenith twilight (in red light) when the earth-shadow passes the 50 km level. D. R. BARBER

551.593.55

5248. Foundations of the theory of twilight phenomena with consideration of the influence of secondary scattering of light in the atmosphere. F. F. IUDALEVICH. *Izv. Akad. Nauk SSSR, Ser. geogr. geofiz.*, **14**, *No.* 6, 562–70 (1950) *In Russian.*

The author develops a geometrical method for calculating the degree of brightness of the secondary scattering of light in the twilight sky. By means of this method the brightness of the secondary scattering is calculated for zenith distances of the sun that ranged from 94° to 107° and a table giving the ratio of the brightness of the secondary scattering to the brightness of the primary scattering is given. This method can be applied to calculate brightness up to 200–250 km. METEOROLOGICAL ABSTRACTS

551.593.9

5249. An approximate solution of a problem of transfer, and its application to the determination of corrections for diffusion in photometric measures of the night-sky light. D. BARBIER. *Ann. Astrophys.*, **15**, *No.* 3, 247–59 (1952) *In French.*

A mathematical treatment of the problem of diffuse-light correction in night-sky photometry. Use is made of the equation of transfer with a polygonial approximation to the source-function. Solutions involving both isotropic and Rayleigh diffusion are found. The treatment is applicable to the case of light emitted from a thin layer of atmosphere at known height, taking account of ground reflectance.

D. R. BARBER

551.593.9

5250. Tables of functions involved in the calculation of corrections for diffusion in photometry of the night-sky light. M. MAYOT. *Ann. Astrophys.*, **15**, *No.* 4, 374–82 (1952) *In French.*

Following Barbier's method (see preceding abstract) of correcting for diffusion in n.s. photometry, tabulations of the functional values, Φ_0, Φ_1, Φ_2, computed by a more rigorous treatment, are given for a range of τ values, 0·0 to 0·7, and for heights of the emitting layer, 0, 50, 100, 200, 400, 800 and ∞ km.

D. R. BARBER

551.594.14

5251. On the measurement of the radioactivity of the atmospheric air with the aid of a gammameter. R. LECOLAZET AND A. HÉE. *Ann. Géophys.*, **8**, *No.* 3, 320–2 (1952) *In French.*

The measurement of the γ-ray intensity as a function of height by the use of an aeroplane is used to separate the effects of cosmic rays from the radioactivity of the air. It is shown that the rays from the earth are negligible at the altitudes of above 300 m used. Preliminary results obtained on two flights are given. Using Eve's formula values up to $8{\cdot}9\times10^{-16}$ curie/cm^3 were obtained. J. M. HOUGH

551.594.14

5252. Radioactive dust from nuclear detonations. M. EISENBUD AND J. H. HARLEY. *Science*, **117**, 141–7 (*Feb.* 13, 1953).

Describes the system set up in the U.S.A. by the Atomic Energy Commission to investigate the effects in the atmosphere caused by tests of atomic weapons. About 50 weather stations have been used and also mobile stations have been established in the vicinity of the detonation. A map is given showing the extra radioactivity produced throughout the U.S. on 1.1.53 due to previous explosions. It is concluded that although shortly after an explosion the level of radioactivity may reach levels much higher than normal this soon decays to a level well below the normal background. J. M. HOUGH

551.594.22

5253. The air discharges and the lower positive charge in a thundercloud. D. J. MALAN. *Ann. Géophys.*, **8**, *No.* 4, 365–81 (1952) *In French.*

The mechanism of "air discharges" which fail to reach earth is discussed. Photographic and field measurements are shown to confirm the presence of a concentrated positive charge at the bottom of a thunder cloud and numerical estimates are given of this charge and of the 2 principal positive and negative charges at different heights of the cloud. The formation of positive space charges as a result of point discharge from earthed objects is discussed and a picture is presented of the average spatial distribution of these charges below and within a thunder cloud. This picture is shown to explain satisfactorily the space and time variation of the e.s. field records obtained during the passage of a thunder cloud as well as the distribution and form of lightning discharges from such clouds. R. H. GOLDE

551.594.221

5254. Boys camera investigation of air discharges and of lightning strokes associated with essentially horizontal cloud discharges. M. SOURDILLON. *Ann. Géophys.*, **8**, *No.* 4, 349–64 (1952) *In French.*

Having drawn attention to the inherent limitations of rotating camera records of lightning flashes a comparative analysis is presented of the case histories of several lightning flashes recorded by a fixed lens and by rotating lenses. It is shown that "air discharges" which fail to reach the ground are more complex than ordinary lightning strokes to earth and give rise to a variety of phenomena according to the distribution and localization of space charges near the bottom of, and below, a thunder cloud. Discharges to earth showing long, essentially horizontal, branches below the cloud are again shown to be of complex nature, the discharge to earth being sometimes initiated from a point of an initial cloud discharge which may precede the earth stroke by a time interval of the order of those between the component strokes of a multiple-stroke lightning flash. R. H. GOLDE

551.594.221 : 535.33

5255. The spectrum of lightning in the region λ 6 159–λ 7 157. C. F. KNUCKLES AND J. W. SWENSSON. *Ann. Géophys.*, **8**, *No.* 3, 333–4 (1952).

A detailed analysis is given of 2 spectrograms in the red region which were obtained from 2 lightning flashes. In the region specified indications are found of Hα and O I, N I and N II. R. H. GOLDE

551.594.7

5256. The geographical and height distribution of the gradient of refractive index. B. R. BEAN. Letter in *Proc. Inst. Radio Engrs*, **41**, 549–50 (*April*, 1953).

Charts are presented of the February and August distribution of the effective earth's radius factor over the United States. Also included is a chart showing the distribution of refractive-index gradient for warm, temperate and cold climates. A.

551.594.7 : 621.317.74.029.6 : 621.396.11

5257. Measurement of tropospheric index-of-refraction fluctuations and profiles. C. M. CRAIN, A. P. DEAM AND J. R. GERHARDT. *Proc. Inst. Radio Engrs*, **41**, 284–90 (*Feb.*, 1953).

For abstract see Abstr. 2856 (1953).

551.596.1 : 551.524.7 : 551.557.2

5258. Stratosphere winds and temperatures in low latitudes from acoustical propagation studies. A. P. CRARY. *J. Meteorol.*, **9**, 93–109 (*April*, 1952).

Tests of sound-ranging method near Hawaii, Canal Zone, Bermuda and Florida are described and velocity-height curves up to 40–60 km (100–120 km near Florida) presented. Most probable temperatures and winds are deduced. The results confirm earlier studies, showing light winds over continental areas in low latitudes in winter and low temperatures and high winds over oceanic areas. The sources of error in this experimental method are discussed.

METEOROLOGICAL ABSTRACTS

BIOLOGY 57/59

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

612.843.621

5259. Studies in physiological optics. III. N. GÜNTHER. *Optik*, **9**, *No.* 12, 557 (1952) *In German.*

For Pt II, see Abstr. 2113 (1953). The equation dealing with the ocular balance is developed. It describes the convergence of the eyes during monocular vision. R. A. WEALE

612.843.621

5260. Studies in physiological optics. IV. N. GÜNTHER. *Optik*, **9**, *No.* 12, 558–9 (1952).

The equation of perception is solved by means of given limiting conditions derived from earlier experiments (Günther, 1948). The constants are connected with the near point of distinct vision during accommodation and convergence respectively.

R. A. WEALE

612.85 : 534.321

5261. Is listening to a telephone a psychologically normal way of hearing? M. F. MEYER. Letter in *J. Acoust. Soc. Amer.*, **25**, 575 (*May*, 1953).

See Abstr. 1313 (1953).

612.85 : 534.321.5

5262. Experimental study of the acoustic, physiological and psychophysiological conditions of musical taste. R. HUSSON. *Ann. Télécomm.*, **8**, 51–72 (*Feb.*, 1953) *In French.*

See Abstr. 6663 (1951).

616–7 : 612.1 : 621.383 : 621.317.79

5263. A portable oximeter with provision for continuous recording. F. D. STOTT. *J. sci. Instrum.*, **30**, 120–3 (*April*, 1953).

The instrument described is a compact ear oximeter for measuring and recording arterial oxygenation in man by a photoelectric method. It is very robust, using a valve amplifier and a milliameter in place of the suspended coil galvanometer used in most other instruments of this type. The earpiece is light, and is designed to make it simple to obtain absolute values of oxygenation. Changes of oxygenation of the order of ½% can be observed and recorded, and the response is sufficiently rapid to show changes at cardiac or respiratory frequencies. A.

616–7 : 612.1 : 621.398 : 621.317.79

5264. An oximeter for continuous absolute estimation of oxygen saturation. W. PAUL. *J. sci. Instrum.*, **30**, 165–8 (*May*, 1953).

An oximeter consisting of an earpiece and associated electronic apparatus provides continuous estimation of oxygen saturation in human arterial blood. The earpiece, made of Duralumin, contains an incandescent lamp, two selenium barrier-layer photocells fitted with suitable gelatin filters and a pressure capsule. An oscillator supplies the lamp with d.c. interrupted at 91 c/s. The a.c. signals from each of the photocells are amplified. The amplified alternating voltages are rectified and each applied to a valve-voltmeter. With the earpiece mounted on the pinna of the ear, air pressure (300 mm Hg) is applied to the pressure capsule, thus removing blood from the transilluminated area. Sufficient positive bias is then applied to each rectifier to set the meters to a fixed point. On release of pressure, blood returns to the ear; the current in one meter (thickness indicator) rises to a finite value depending on the amount of blood in the illuminated vascular bed; the current in the other meter (saturation indicator) rises to a value depending on both the amount of blood in the vascular bed and its state of oxygen saturation. The "saturation" meter is calibrated to read % oxygen saturation directly when a variable shunt has been adjusted according to the reading on the "thickness" meter. Instrument accuracy, expressed as standard deviation measured with three earpieces, was ±3·8, ±3·3 and ±3·2% respectively. A.

TECHNICAL MATERIALS 66/67

66.07

5265. Experimental study of rubbers for the membrane of an expansion chamber. A. MILOJEVIĆ. *Recueil Trav. Inst. Rech. Struct. Matière [Belgrade]* **1**, 85–7 (*July*, 1952) *In French.*

Tests have been carried out to determine the type of rubber least likely to emit vapours and cause fogging of the chamber. Synthetic rubbers were generally found to be superior to natural rubbers, and an optimum composition is specified. J. J. WILKINS

PHOTOGRAPHY 77

771.3 : 535.31

The resolving power for the combination of photographic plate and objective. *See Abstr.* 4683

771.53

5266. On the mode of action of desensitizers. VIII. A. HAUTOT AND H. SAUVENIER. *Bull. Soc. Roy. Sci. Liège*, **21**, 497–513 (*Dec.*, 1952) *In French.*

For Pt VII, see Abstr. 2121 (1953). Two kinds of emulsion are distinguished by the max. attainable density after desensitization: type 1, in which this is equal to or greater than that obtainable in the untreated emulsion, and type 2, in which it is less. Most of this article concerns type 2. Treatment with a Br acceptor after desensitization restores the max. density to that of the untreated emulsion or even increases it. Exposures both before and after desensitization produce latensification except for higher values of both exposures, when regression of the latent image occurs (though not for type 1 emulsions). The second exposure, if in presence of a Br acceptor, leads to regression only for still higher exposures. Spectral sensitivity experiments for the second exposure show that the regression is a Herschel effect for longer wavelengths, but for shorter wavelengths is due to rebromination of latent image specks.

S. T. HENDERSON